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Evaluating the Role of the Base Volume in the Liquidity of Digital and Knowledge-Based Companies' Stocks in the Tehran Stock Exchange

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Abstract

Purpose: This research aimed to identify some of the existing financial frictions in the Iran's digital economy. In particular, based on cases taken from digital and knowledge-based companies, it empirically investigated the importance of the role of base volume in the liquidity of those companies' stocks in Tehran Stock Exchange.

Method: To evaluate the empirical implications of applying the base volume in daily stock market practice, retrospectively a quantitative estimate of the base volume was implied by the economic model within the rules imposed by the market regulator via MATLAB software programming. Then, using the Generalized Method of Moments (GMM), the effects of the estimated base volume, percentage of free-floating share, securities turnover, and the ratio of transaction volume to base volume on Amihud index were econometrically studied for the selected companies during the period 2015-2020.

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Findings: The findings indicate that the applying base volume on the selected digital and knowledge-based companies has had a negative effect on the calculation of the final price and on the liquidity of studied knowledge-based companies. Also, the results of using the machine learning method (decision tree) showed a importance coefficient of 32.6% for the base volume on the Amihud index of the selected companies.
Conclusion: Our results suggest that base volume as an idiosyncratic financial friction induced by Iranian stock market regulator has aggravated the illiquidity of studied digital and knowledge-based companies and thereby could have raised the financing costs for those companies. This would ultimately impede those companies' growth prospect.

Keywords: Base volume, Digital Companies, Knowledge-Based Companies, Liquidity, Digital Economy, Knowledge-Based Economy
GEL classification: O16, N25, G14, D5.

Introduction

Digital technology has rapidly transformed the economy in the last decade, especially in the field of e-commerce and digital finance (Dai et al., 2022). In many ways, digital technology is changing the paradigm of economic activities as it increases business scale, and economic efficiency, improves user experiences, reduces operational costs, and controls financial risks (Jiang & Zhang, 2021). The difference between the boom in the old knowledge economy and the boom in the new digital economy is the speed that digital and knowledge-based companies can create using data and digital tools (Liu, 2022). Technology—and its rapid adoption—is creating unprecedented opportunities for companies to serve new markets around the world. Inclusive business models and products offer better ways to reach disadvantaged communities. For example, some academic webinars attract millions of viewers online. Hundreds of millions of consumers buy products from the same e-commerce platforms. Some social media platforms serve billions of users simultaneously (Liu, 2021).

Both the scale and speed of economic activity have reached levels never seen before in human history. In the new era, the main driving force of development is the digital and knowledge-based economy (Tarek, 2020). An economy whose main part is the knowledge economy (Smith, 2002), which deals with the production, distribution, transfer, and use of knowledge (Amirat & Zaidi, 2020). The ever-increasing expansion of information and the prominent role of the Internet in human life have led to new events and major changes in the process of doing things. Technology reduces costs by maximizing economies of scale. This increases the speed, security, and transparency of transactions and enables the development of sustainable financial products tailored to the needs of people with very low and irregular incomes (Li, Rao & Wan, 2022). Technology removes barriers to providing financial services such as lack of identification and formal income and geographical distance (Wang, Bu & Liu 2022). Also, the recent COVID-19 pandemic has increased the necessity of developing the digital economy(Xu & Zhao, 2020).

Many simplified financial operations are now possible with the use of digital technology. It is a real economic revolution brought about by digital technology (Fang, 2021). In this context, digital and knowledge-based companies need to increase capital to launch a new development plan, promote growth and productivity, etc., which can be financed

from internal sources (retained earnings) or external sources (financial sector) (Paun et al., 2019). Transaction cost can play an important role in the foreign financing of companies. However, due to the risky nature of these companies and on the other hand, not having favorable collateral conditions due to their fledgling nature, financing from the securities market (equity) is more favorable than debt instruments. On the other hand, based on the viewpoint of new institutionalist schools, the exchange cost is not zero, and neoclassical economists do not accept the assumption that the exchange cost is zero (Nikonesbati & Momeni, 2016). According to the conducted research, among the 21 countries surveyed in the region in 2012, Iran ranked 14th in terms of knowledge-based economy and ranked last in terms of laws and regulations (Rahbar & Alam Al-Hadi, 2015). On the other hand, these laws and regulations cause the exchange cost to rise, which according to the new institutionalists' point of view, these costs should be reduced, and in this case, economic agents decide on the best option due to their limited rationality.

Digital and knowledge-based companies listed on the Tehran Stock Exchange must increase their size to have an impact on the macro economy, which will require financial resources that can be financed by the Tehran Stock Exchange (Liu et al., 2020). Financial resources from the Tehran Stock Exchange are provided if, firstly, the liquidity of the market is high, and secondly, the liquidity resources of the market are directed towards knowledge-based companies in order to be more effective in the new era when the changes in knowledge are more extensive than the changes in developments from agriculture to industry. (Levy, Sissons & Holloway, 2011). In the period of industrialization, capital accumulation was the main axis of development, while in the modern era, knowledge storage and accumulation form the main axis of development (Ding & Qin, 2021).

Economic and non-economic factors are effective in the entry of liquidity into the securities market. Economic factors include interest rates, exchange rates, etc., and non-economic factors include the rules and regulations governing the market, which are considered a kind of exchange cost (Abeysekera, 2021). These costs include implied and non-implied costs. Implicit costs include taxes and commissions and non-implicit costs embody rules and regulations governing the market, of which automatic stops are the most important one. Automatic stops include trading halt, price limit, and base volumes. In the Tehran stock

market, since 2002, the limit of the range of fluctuation and the base volume has been used to calculate the final price of shares. Examining the implications of the financial frictions in the Tehran Stock Exchange market is necessary for financing companies in general and especially digital and knowledge-based companies, considering the general feature of not having valid and potentially high-risk documents. Because under equal conditions, efforts to reduce financial frictions can increase the liquidity of the securities market, and in this way, it is possible to provide financial resources in a more efficient way for knowledge-based companies that play an essential role in the dynamics of economic development in the new era. One of the most important financial frictions is automatic stops, which include trading halts, price limits, and base volume. The main purpose of this research is to study the effect of the base volume on the liquidity of the digital and knowledge-based companies of the Tehran Stock Exchange.

The current research aims to investigate the role of the base volume in the liquidity of securities (shares) of knowledge-based and digital companies in the Iranian stock market, and if the application of this mechanism has a negative effect on their liquidity, it is more desirable that the presented mechanism be adjusted If the adverse effects of applying the base volume on the liquidity of the shares of this group of companies are reduced, their exchange cost for financing from the securities market will be reduced. And these companies can expand their development plans with less cost and help the growth and development of the country through it. Despite the importance of the topic, unfortunately, until now, no research has been done to scientifically evaluate and pay attention to the effect of the base volume on the liquidity of Tehran's stock market using standard methods. Therefore, the current research is looking for an answer to the following question: what is the role of the base volume in the liquidity of the stocks of digital and knowledge-based companies in the Tehran Stock Exchange market?

A review of literature and research background

Knowledge-based digital economy

Widespread access to telecommunications and computer technology creates new ways of working and socializing (Tang, Wu & Zhu, 2020). The growing role of the digital economy in everyday life has increased the supply and demand of new data. This revolution has paved the way

for a new age of information and has given rise to the fourth industrial revolution or "Industry 4.0". It is mainly characterized by the processing of very large volumes of data thanks to the development of algorithms and mathematical models to support innovative technological solutions. This fourth industrial revolution also promises to revise the entire traditional production system beyond the mere optimization of production resources (Yu & Yang, 2021). This evolution begins to integrate business practices through the so-called platform economy and the emergence of global digital giants such as Google, Amazon, Facebook, and Apple, among many others. Many startups also offer a wide range of services thanks to new technologies. But the accounting behavior of the transactions created by these new actors is hindered by the existing accounting frameworks (Qu, Shao & Shi, 2020).

The emergence of big data, the digital revolution, and social media is also drastically changing decision-making processes. These new technologies make it possible to directly connect supply and demand and thus modify traditional value creation processes. New types of transactions are emerging with the rise of platforms (such as Uber) and the sharing economy, where the consumer is part of the value creation process. Customer experience is central. Therefore, this new digital context is likely to change financial management and accounting (Hassen, 2020). The bridge between this new digital context and the value of the company lies in the integration of knowledge in the digital economy and is reflected in intellectual capital, a concept translated as intangible assets in financial accounting (Yan & Wu, 2021).

The emergence of the information economy has created a potential competitive advantage in the form of so-called knowledge-based intangible assets. The areas of knowledge management and intellectual capital are related to the identification and effective management of knowledge to achieve this competitive advantage. Over the past few decades, companies have gradually entered a knowledge-based economy characterized by rapid technological changes. The production of physical goods is no longer the main source of value creation but has been replaced by the creation and management of intangible assets (Zhao, Zhang & Liang, 2020).

Due to this situation, companies increasingly need to invest in intangible assets (Bukht & Hicks, 2018). Digital transformation is the result of major advances in technology and information technology, and

therefore the issue of investment in research and development becomes more obvious. These digital transformations and the emergence of a new knowledge-based economy create value that can take the form of intangible assets. (Huang, Qiu & Wang, 2021). in their article entitled DDigital hechnologh and 'cono mic Impacts oh ss lll -19: ppperiences of the People's 'epu'li c of ,,ina,, swowtwathigh speed and low costs in the digital economy require special financial planning and strategy. (Ivanovo, hukyyanova & Belova, 2020). showed that the technological revolution in Industry 4.0 is happening fast and this process is determined by the spread of information technology, which leads to the transition to the digital economy and the higher role of knowledge in society.

Carpenter et al. (2002) investigated the appropriate financial instruments for the development of knowledge-based enterprises in the US on 2400 high-tech and knowledge-based enterprises from 1981-1998. They showed that there are many financial constraints for small high-tech firms due to information asymmetry and collateral problems. They also showed that for high-tech companies that have the goal of investing in the company, financing by issuing securities is evaluated as more favorable than financing by debt instruments. This research states that it is better to issue securities for financing knowledge-based companies, involving risky investment. Since financing of the securities market depends on the institutional environment and the law and tax policies, etc., in such circumstances, government support can be effective. Wonglimpiyarat (2012) with a comparative analysis of four countries, Malaysia, Singapore, Taiwan, and Thailand; has addressed the role of government policies in financing knowledge-based companies from the stock market. This research showed that financing by issuing shares in the stock market in all four countries had a positive effect on entrepreneurship, the growth of knowledge-based companies, and their innovation. Also, this research showed that Singapore and Taiwan had more effective financing in encouraging financing from the securities market than Malaysia and Thailand. In addition, the research shows that the government has played a better role in providing risky investments in Singapore and Taiwan than in Malaysia and Thailand. In particular, the two successful countries have had capital markets that have supported new and high-tech businesses. Therefore, as deduced from this research, for the development of knowledge-based enterprises, the capital markets should be expanded, and the

government should play an important role in facilitating the laws and regulations governing them.

He and Tian (2013) discussed the relationship between market liquidity and firm innovation and showed that increasing capital market liquidity causes knowledge-based firms to be taken over. That is, a special group enters this market with short-term goals to acquire the majority of the company's shares, and this issue causes innovation, which is one of the long-term goals of the board members and the CEO of these companies, to be abandoned, and they seek to maximize profits within the possibly shortest time. In this research, it is stated that of course, the liquidity of the capital market is influenced by the laws and regulations governing it, which is assumed as a kind of exchange cost. In this research, exogenous variables that are effective in creating liquidity were used, which is actually considered the same as the exchange cost. (Jiang, 2015). points out that companies increase productivity through knowledge transfer, introduce the concept of dynamic capability, and emphasize that knowledge acquisition and use can increase the performance of companies and the transfer model of knowledge is developing.

Giebel and Kraft, (2020) conducted a research covering 348 companies in Germany during the financial crisis period of 2007-2008. The cause was the banking crisis in that period. In Germany, there are three types of banks: private, public, and cooperative. This research showed that the crisis created between three types of banks was effective on the innovation activities of knowledge-based companies, and knowledge-based companies should use other sources in addition to the bank to develop their activities. Therefore, the crisis of 2007-2008 shows the insufficient efficiency of the banking system in financing knowledge-based companies (Chundakkadan & Sasidharan 2020). In their research related financial constraints and government support to innovation for 100 countries between 2006-2017. This research simultaneously looked into the effect of financial restrictions on the innovation of knowledge-based companies and the government's financial support for them and showed that financial restrictions have a negative effect on the innovation activities of companies. They also found a positive and significant relationship between government support and innovation activities.

Meanwhile, based on the research, the main driver of progress in the digital economy is knowledge, including formal and tacit

knowledge belonging to management and employees, which acts as a platform for the company's dynamic capabilities. The purpose of this study is to explore the relationship between the role of base volume in the liquidity of digital and knowledge-based companies in the digital ecosystem with key links such as knowledge exchange and advanced technologies.

While knowledge and digitization are often seen as being at odds with each other, the US offers at least one good example of digitization as a lever to add more value in the form of knowledge. In essence, the example bodes promisingly well for the emergence of a new, up-to-date knowledge management. Based on the studies, liquidity and financial factors are important in knowledge and digital companies. For the first time, this research examines the role of base volume in stock liquidity in selected knowledge-based and digital companies that are members of the stock exchange.

Method

This research, first estimates the base volume, Amihud index, securities circulation, and percentage of free-floating shares of knowledge-based companies. Then the analyzes related to correlation coefficients and cross-sectional ordinary least squares regression were performed for the year 2020 then in order to expand the discussion and find stable results, the period of the analysis was extended to 6 years since the third mechanism was started and the analytical framework of data Dynamic panel (Farmanara et al., 2018) has been used to empirically investigate how the mentioned variables affect the liquidity of selected companies based on fixed, random, and integrated effects estimation models and the GMM method. 30 knowledge-based and digital companies are members of the stock exchange, and all their information was reviewed in 2020.

Amihud Index: In this research, the daily closing price of securities, the volume of daily transactions and the number of days the securities were traded were used to obtain the Amihud index of knowledge-based companies. Programming and MATLAB software were used to separately calculate the Amihud index of each of the knowledge-based companies.

Percentage of free-floating shares: Morgan Stanley company has defined free-floating shares in the following manner: "A percentage of the company's shares that can be traded in the market and are not held

by strategic shareholders for management purposes" (Ahmadpour & Khakpour, 2017). In the Iranian stock market, the percentage of free-floating shares is reported on a quarterly basis, and in this research, the annual average has been calculated for knowledge-based companies.

Shares turnover: This measure is obtained from the ratio of traded shares to the number of issued shares. VOLt is the traded volume in year t and SHAREt is the number of company shares in year t (Ramesheh, 2013). Obtaining securities circulation requires the volume of annual transactions and the number of shares of companies. The number of shares of the companies is obtained by dividing the capital of the companies by the number of 1000 Rials (nominal price).

$$TO_t=\frac{VOLt}{SHAREt}$$

Calculation of base volume: The implemented method is the method of calculation of base volume according to notification number 72176/181 dated March 8, 2018 (Resolution regarding determining the base volume in Tehran Stock Exchange, 2018). In the years 2016-2020, the minimum base value for all companies was equal to 500 million Rials, and the maximum base value for companies with a capital of 20 thousand billion Rials and below was 12 billion Rials, and for companies with less than 20 thousand billion Rials, 10 billion Rials. Using programming and MATLAB software, the base volume of digital and knowledge-based companies for the period 2015-2020 was obtained using the average final price, Pmin and Pmax. In addition, after dividing the average volume of daily transactions by the base volume obtained, $\frac{V}{BV}$ ratio was obtained.

Table 1. The results of calculating the base volume implemented for knowledge-based companies in 2020

firm	name	value	volume	pmean	pmin	Pmax	bv
1	Shetoka	2/3E+13	4/58E+08	50183	833333	1666666	996345
2	Darehavar	1/91E+13	3/97E+08	48171	625000	1250000	1037967
3	Rafza	4/43E+12	79876167	55461	625000	1250000	901540
4	Deshimi	2/55E+12	4/38E+08	5820	446430	892859	858707
5	Chlor	5/01E+13	5/26E+08	95319	381679	763359	524551
6	Dabalk	2/58E+13	1/14E+09	22580	337838	675676	2214400
7	Daveh	2/25E+13	7/5E+08	30011	260416	520833	1666079
8	Zefka	2/09E+13	5/25E+08	39807	208333	416667	1256058

firm	name	value	volume	pmean	pmin	Pmax	bv
9	Afra	1/81E+13	4/16E+08	43474	200000	400000	1150112
10	Shafaras	3/37E+13	7/39E+08	45595	198728	397456	1096610
11	Madaran	1/45E+13	4/68E+08	30990	192307	384615	1613445
12	Fanval	2/39E+13	7/34E+08	32561	184365	368732	1535576
13	Khatrak	1/55E+13	7/94E+08	19520	178571	357143	2546150
14	Shasdaf	1/15E+12	45891312	25059	234521	469043	1995300
15	Kasra	4/26E+13	1/39E+09	30540	150602	301205	1637202
16	Desanco	2/05E+13	9/73E+08	21061	130208	260417	2374089
17	Fazer	6/9E+13	2/01E+09	34256	125000	250000	1459610
18	Besvich	7/99E+12	1/32E+08	60751	125000	250000	823037
19	Aparadz	3/38E+13	1/14E+09	29645	125000	250000	1686639
20	System	1/47E+13	4/95E+08	29670	96154	192308	1685187
21	Khamotur	1/64E+13	1/06E+09	15419	87474	174948	3242770
22	Chodan	4/6E+13	1/43E+09	32175	73529	147059	1557386
23	Pardakht	1/29E+13	3/22E+08	40096	66845	133690	1247019
24	Rakish	2/81E+13	1/56E+09	17986	48077	96154	2779873
25	Ap	4/11E+13	1/43E+09	28763	47170	943396	1738330
26	Sep	3/02E+13	9/01E+08	33536	32612	65223	1533200
27	Retap	3/02E+13	2/33E+09	12967	26042	52083	3855949
28	Farak	1/28E+14	1/1E+10	11638	19882	397646	4296875
29	Foulazh	2/38E+13	1/02E+09	23292	17857	35714	2800000
30	Ranfur	1/14E+14	3/16E+09	36124	14880	29762	2768250

Findings

The variable d10 with a value of one in this research indicates the effect of the base volume on the final price and d10 with a value of zero means no effect of the base volume in the calculation of the final price, and therefore d10 is a dummy variable. Correlation coefficients between the Amihud index and $\frac{V}{BV}$, d10, cap, FF, and MTE have been reported for knowledge-based companies in 2020. where $\frac{V}{BV}$ is the ratio of trading volume to base volume; dummy variable d10; capital cap, FF is the percentage of free-floating shares, and MTE is the share turnover. Since the correlation coefficients between the Amihud index and $\frac{V}{BV}$, cap, FF, and MTE are negative, it indicates the presence of a negative association between the illiquidity index and the mentioned variables. And the negative relationship between capital, free-floating shares, and securities circulation with Amihud indicates that the size of companies and the increase in the percentage of free-floating shares, and the increase in securities circulation has a positive effect on the liquidity of

digital and knowledge-based companies in 2020. The negative correlation coefficient of $\frac{V}{BV}$ indicates a positive relationship between the Amihud index and the base volume, and the application of the base volume has a negative effect on market liquidity in 2020. But the results about MTE and FF are meaningless. In addition to that, d had a positive relationship with the Amihud index and it means that the use of the base volume mechanism in calculating the final price has a positive relationship with the Amihud index (illiquidity index) and it means the calculation of the final price with the volume mechanism. The basis is the negative effect of market liquidity.

Table 2. Correlation coefficient, t-test and significance test between Amihud index and independent research variables

	AMIHUD	D01	V_BV	CAP	FF	MTE
AMIHUD	1.000					
D01	0.621	1.000				
t test	4.194	-----				
The significance level	0.000	-----				
V_BV	-0.511	-0.353	1.000			
t test	-3.143	-1.996	-----			
The significance level	0.004	0.056	-----			
CAP	-0.561	-0.187	0.477	1.000		
t test	-3.584	-1.009	2.869	-----		
The significance level	0.001	0.322	0.008	-----		
FF	-0.215	-0.233	0.359	-0.302	1.000	
t test	-1.166	-1.267	2.033	-1.677	-----	
The significance level	0.254	0.216	0.052	0.105	-----	
MTE	-0.114	-0.357	0.317	-0.351	0.699	1.000
t test	-0.606	-2.022	1.771	-1.981	5.168	-----
The significance level	0.549	0.053	0.087	0.058	0.000	-----

For a more detailed analysis and to observe the effect of the simultaneous changes of each of the mentioned independent variables on the Amihud index, an econometric model was used as well as the OLS method. For the simultaneous effect of the mentioned independent variables on the Amihud index, different combinations were measured, and the best result related to OLS regression is reported in Table (3).

Table 3. Estimation of regression equation coefficients with OLS in 2020

Variable	Coefficients	The standard deviation	t statistic	Possibility
dummy variable	1.52E-08	4.26E-09	3.573512	0.0015
The ratio of trading volume to base volume(V/BV)	1.76E-10	8.95E-10	0.196623	0.8457
Capital(cap)	-2.75E-11	7.79E-12	-3.530958	0.0016
Percentage of free floating shares(FF)	-1.57E-08	8.27E-09	-1.900503	0.0690
Width from the origin (c)	2.44E-08	2.92E-09	8.354415	0.0000

The significance level	Watson Durbin	Adjusted coefficient of determination	The coefficient of determination
0.000015	1.593	0.6	0.655

V/BV is meaningless, but d01 has a positive relationship with the Amihud index, and it means that using the base volume mechanism to calculate the final price has a negative effect on market liquidity. But the same regression shows that Amihud has a negative relationship with FF and cap. In other words, increasing the size of companies in terms of capital and increasing the percentage of free-floating shares have a positive effect on market liquidity. In order to more closely examine the effect of the mentioned independent variables on the Amihud index, instead of cross-sectional data related to the year 2020, panel data for the period 2015-2020, i.e. when the third mechanism of base volume was proposed and implemented, was used covering 30 digital companies and knowledge-based companies accepted in 2020. Only 16 companies have been accepted in the stock market since 2015 (Shetoka, Deshimi, Debalak, Afra, Shefaras, Madaran, Fanval, Khatrak, Fazer, Besvich, Khamotur, Rakish, Retop, Farak, Foulazh and Ranfur) therefore the information of these 16 companies have been used for the balanced panel analysis.

Table 4. The result of the group unit root test between variables

	statistics	Significance	section	observations	Results
Levin, Lin & Chu t*	-7.49975	0.0000	6	563	Absence of unit root
Im, Pesaran and Shin W-stat	-9.13001	0.0000	6	563	Absence of unit root
ADF - Fisher Chi-square	123.167	0.0000	6	563	Absence of unit root
PP - Fisher Chi-square	116.933	0.0000	6	570	Absence of unit root

First, the group unit root test was performed on the variables, and after rejecting the hypothesis of the existence of a unit root, dynamic data panel analyzes were performed on the data.

Table 5. Results related to f Limer

Test	Statistics	Degrees of freedom	Possibility
F	2.93357	(15.58)	0.0017
Chi Square	45.169722	15	0.0001

In the first step of running the regression model, the existence of heterogeneity among sections can be determined by using F Limer test. The null hypothesis of statistics is based on the homogeneity of sections (pooling of statistical data). If the null hypothesis is rejected, the opposite hypothesis based on the existence of heterogeneity between sections (panel data being statistical data) is not rejected. The results of the F limer test after estimating the panel regression model with fixed effects indicate the rejection of the null hypothesis and the existence of heterogeneity between sections at the 5% level. In fact, it indicates the appropriateness of the panel data method for estimating the model.

Table 6. Hausman's test

Chi-square statistic	Degrees of freedom	Significance
43.959762	6	0.0000

Therefore, the Hausman test was used to determine fixed or random effects. Since the data was not aggregated, either they are a panel with fixed effects or a panel with random effects. In order to achieve the aforementioned goal, first, panel data estimation was done with random effects. According to the rejection of the hypothesis H0 (pvalue < 0.5),

the panel with fixed effects is confirmed. However, since the estimates obtained from the random effects method are not compatible with the dynamic panel models, the dynamic panel data model was done using the GMM method Estimation. According to the GMM model, differentiation is done first, so that the effects of sections can be removed from the model , and in the next step, residuals from the first step can be used to balance the variance-covariance matrix. The consistency of GMM depends on the validity of the hypothesis of serial non-correlation of error sentences and instruments and can be tested by means of two specified tests of Arellano and Bond (1991) (Bahrami Zenouz et al., 2021). Sargan's test is a predetermined limit that tests the validity of the tools. The Sargan test statistic (J-Statistic) has a distribution with degrees of freedom equal to the number of excess restrictions. The second test is for serial correlation, which tests the presence or absence of second-order serial correlation in first-order differential error sentences using the M2 statistic. In this test, the GMM estimator is consistent when the second-order serial correlation in the error sentences does not have the first-order differential equation. Failure to reject the null hypothesis of both tests implies the assumption of no serial correlation and the validity of the tools. In this research, Sargan test was used to check the consistency of the GMM estimator. Eviews9 software was also used for statistical and econometric analysis.

Table 7. GMM model estimation results for knowledge-based companies with instrumental variables @DYN(AMIHUD,-2) CAP(-1) FF(-1) MTE(-1)

Possibility	t statistic	The standard deviation	Coefficients	Variable
0.0000	-29.50391	0.020775	-0.612929	Amihud with a lag
0.0000	12.05708	2.46E-07	2.97E-06	Dummy variable
0.0010	-3.454730	6.20E-09	-2.14E-08	The ratio of trading volume to base volume
0.3014	1.042697	4.69E-09	4.90E-09	Capital
0.0031	-3.083031	1.12E-06	-3.47E-06	Percentage of free floating shares
0.0012	-3.404213	1.30E-07	-4.43E-07	Share turnover

Significance level	(Sargan) J	Order of tools
0.206684	9.692	13

Significance level	SE	Statistics m	Test order
0.0000	0.000000	-5.329014	AR(1)
0.6825	0.000000	-0.409027	AR(2)

According to the table (7), the closing price of securities has a direct relationship with V/BV, and if it is above one and less than one, the mentioned ratio is multiplied by the average price to get the final price. Since the V/BV coefficient was negative, the Amihud index has a direct relationship with the base volume, and in other words, the existence of the base volume in the calculation of the final price has fueled the illiquidity of the relevant shares in the market. For BV smaller than a dummy variable indicated by D has been used, so the mentioned ratio has a direct relationship with the illiquidity of shares in the market (Amihud index) and it is understood that the use of the base volume in calculating the final price has a negative effect on liquidity market. In other words, using the base volume mechanism in calculating the final price has a negative effect on the liquidity of the shares included in the market. The percentage of free-floating shares (FF) has a negative relationship with the Amihud index (illiquidity index) and it means that the increase in the percentage of free-floating shares of the company had a positive effect on the liquidity of shares of knowledge-based companies within the period of 2015-2020.

Share turnover (MTE) shows how many times knowledge-based companies have been traded in a year. And this ratio has a negative relationship with the illiquidity index, the Amihud index, which shows that as the ratio of the volume of corporate transactions to the number of its shares is more, their liquidity increases, which is true for knowledge-based companies. The results of the first-order autocorrelation test of AR (1) show that the null hypothesis is rejected as the p-values of Arellano and Bond statistics in tables (7) show. The level of 1% is significant. The results of the second-order autocorrelation test AR (2) do not reject the null hypothesis of the absence of autocorrelation. As it can be seen, the existence of the base volume has had a positive effect on the illiquidity index. The increase in the percentage of free-floating shares and bond circulation Bahadar has a negative relationship with the Amihud index, which means that it is related to the liquidity of the bank . Also, based on these results, the relationship between the company's capital and the Amihud index is

meaningless.

Table 8. The results related to the above decision tree.

Feature name	Importance
v/bv	.328
Mte	.246
FF	.202
cap	.187
D	.036

After repeating the decision tree 50 times to obtain the parameters of the decision tree from the grid search, the following results were the most frequent. By using these criteria, the importance and influence of each of the explanatory variables considered in this study in the Amihud index was as follows (the sum of the coefficients is equal to one). Amihude index is 0.326. In addition, the significance of MTE in Amihude index was equal to 0.246 and FF equal to 0.202. The importance of capital in the Amihud index was 0.187, and the influence of the importance of the dummy variable in calculating the final price based on the decision tree was 0.036 percent.

Conclusion

Our society is on the brink of a digital revolution, made possible not only by digital technology and economic changes, but also by the way people communicate through computers, smartphones, and the Internet. Information transformed into knowledge and transferred to the network space has become the basis of the digital economy. In this research, to analyze the effect of using base volume on the liquidity performance of stocks of knowledge-based and digital companies, the Amihood index and a case study of digital and knowledge-based companies admitted to the Tehran Stock Exchange were used. To make the research into capital variables more complete, the percentage of free floating shares and the circulation of securities transactions were extracted. The exchange of knowledge, the technologies that enable it, and the people who can participate in and manage this exchange are key factors in the digital economy.

As it can be inferred from the results of this research, applying the base volume mechanism has had a negative effect on market liquidity in digital and knowledge-based companies. In other words, although the provision of this law has prevented speculation, it has had a negative effect on the liquidity of the shares of knowledge-based companies.

According to the efficient market theory everything lies in the price, but the application of the base volume in the calculation of the final price of the multiplier has caused the illiquidity of the shares of knowledge-based companies. Also, in this research, for the first time, the decision tree was used to identify the importance of different factors in market liquidity (Ramos et al., 2022), and it was shown that the importance of the base volum in the Amihud index (illiquidity index) for knowledge-based companies is different from others. There have been more factors. As mentioned, Iran's position in the institutional regime is not favorable for knowledge-based companies, which is one of the cases in the institutional regime of rules and regulations governing institutions (Hajiha & Jafarpour, 2019). As mentioned earlier, the application of the base volume has had a negative effect on the liquidity of their shares in the market for knowledge-based companies, and this problem has reduced the efficiency of the market in financing this group of companies. If the knowledge-based companies are not able to finance easily at the lowest cost, the development plans of these companies won`t be implemented and the resources instead of being directed to these companies in other economic sectors will be wasted and so will economic growth and development in the digital era with a focus on knowledge. (Ryu, Webb & Yu, 2022). The results are consistent with those of the research conducted by Tian et al. (2013).(Giebel & Kraft, 2019). confirmed the obtained results.

According to the findings of this research, free-floating shares have had a positive effect on the liquidity of the shares of these companies in the market, and it is more desirable to present the base volume in such a way that with the increase in the percentage of free-floating shares, the number of the base volume decreases. According to the results, the securities circulation of knowledge-based companies has a positive relationship with liquidity, and in general, an increase in the share turnover causes an increase in the market turnover. This can be a basis for considering this component in the calculation of the base volume, while currently, the implementation of the base volume mechanism is not in accordance with the share turnover. Based on the results obtained in this research, it is suggested that proper arrangements should be made for handling the financing processes of digital and knowledge-based companies.

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