

An Empirical Research of Impact of the Merger of Pan-European and Oslo Stock Exchanges on the Efficiency of Tobacco Securities Market

Dongpeng Xu, PhD Candidate

Deqin Lin, PhD and Assistant Professor

Dan Zhang, PhD Candidate

Dongpeng Xu, PhD Candidate in Financial measurement and modeling, Risk management and emerging capital markets, Faculty of Finance, City University of Macau, Macao. Deqin Lin, Assistant Professor in Financial measurement and modeling, Risk management and emerging capital markets, Faculty of Finance, City University of Macau, Macao. Dan Zhang, PhD Candidate in Industrial economics. Institute for Research on Portuguese-speaking countries, City University of Macau, Macao. Correspondence: Deqin Lin; dqlin@cityu.mo

Objectives: Europe is one of the important markets for traditional tobacco. We analyzed the impact of exchange consolidation on securities market efficiency, so as to enable tobacco enterprises to improve the financing efficiency of the stock market and carry out transformation and upgrading. **Methods:** In this work, We're based on efficient market theory, the merger of Pan-European Stock Exchange and Oslo Stock Exchange, Norway in June 2019 is analyzed through empirical analysis. The logarithmic returns of 25 listed companies in the Oslo Stock Exchange OBX-25 index were analyzed using OLS, Chow and KPSS tests. **Results:** It is found that of 72% of securities, the explanatory power of market returns for securities returns is increased, which shows significant improvement in market efficiency. The merger of stock exchanges can indeed improve the market efficiency. In addition, through the KPSS test, it is found that the merger of stock exchanges can improve the market efficiency. As time goes by, however, the validity decreases. **Conclusion:** The improvement of the efficiency of the securities market will be conducive to the financing efficiency of listed tobacco companies in the secondary market, promote the transformation of enterprises, and contribute to the tobacco control and the health of the population in Europe.

Key words: stock exchange; mergers; tobacco; market efficiency

Tob Regul Sci.™ 2021;7(4-1): 568-587

DOI: doi.org/10.18001/TRS.7.4.1.9

INTRODUCTION

Traditional cigarettes have a history of more than 500 years, from a luxury product to a mass consumer product. With people's increasingly profound understanding of the dangers of smoking, the disadvantages of traditional cigarettes are becoming increasingly prominent. With the promotion of the World Health Organization, social attitudes towards smoking and

consumption are gradually changing. Ninety-three percent of the WORLD Health Organization's 195 member states have signed the Framework Convention on Tobacco Control, covering more than 90 percent of the world's population. Europe is the major seller of cigarettes in the global market. The EU alone sold 9.84 million cartons in 2017. Therefore, Europe has introduced various policies on tobacco control, such as increasing tobacco excise

tax, introducing plain and standardized cigarette packaging, and setting up more non-smoking areas.

Traditional tobacco enterprises will face greater resistance in their operation. Due to the increasing social awareness of the harm of cigarettes, the burden of social responsibility of tobacco enterprises will be further increased. Therefore, tobacco enterprises need to seek a balance between maintaining their own operation and taking responsibility for social welfare. Tobacco enterprises raise funds through the securities market, and improving the financing efficiency is of great help to accelerate the transformation and upgrading of enterprises. In addition, as the second largest e-cigarette market, Europe also provides new development opportunities for tobacco enterprises.

Global exchange mergers have been common since 2000, but there are relatively few successful cases of cross-border stock exchange mergers. The mergers and acquisitions, reorganizations, business innovations, and institutional changes of major stock exchanges around the world are endless. Under the premise of global integration, the merger of international stock exchanges reflects the development of financial globalization and has become the future development trend of stock exchanges. According to the 2007 London Economic Report, a more open and effective European financial market will have greater appeal, which provides easier access to financing opportunities and more attractive financial products. Clearly, market efficiency is an influencing factor that affects the development of regional financial markets. The impact of the merger of stock exchanges on the efficiency of the stock market has aroused widespread concern and research in the academic community.

In the past, scholars studied the impact of the merger of stock exchanges on the improvement of market liquidity by the merger of stock exchanges¹ and the cost of corporate financing². There are relatively few tests on the impact of stock exchange mergers on market efficiency.

Walaye

t Khan and João Paulo Vieito³ first began to analyze the market efficiency of European stock exchanges after the merger based on the efficient market hypothesis. Then, Siu Tung Ho⁴ and Shawing Yang⁵ analyzed the case of exchange mergers in the Southeast Asian market, and the results showed that the merger of stock exchanges can help improve the level of market efficiency.

Therefore, this work hopes to analyze the merger of Pan-European Stock Exchange (Euronext N.V.) and Oslo Stock Exchange, Norway (Oslo Stock Exchange) in 2019. Earlier studies by scholars such as Yavrumyan Evgenia⁶ and Capstaff John⁷ found that the Norwegian stock exchange was not highly market efficient. After the Pan-European Stock Exchange has undergone many mergers and acquisitions, and considering its capital and scale, it is believed that its market efficiency will be better than that of the Norwegian Stock Exchange. Therefore, this work hopes to explore the reasons for the successful merger of the stock exchange through empirical analysis. After the merger of the stock exchange, the effective market theory is used as the premise, through the OLS regression model, the Chow test, and the KPSS test of the unit root, an empirical analysis of the stock prices of 25 listed companies involved in the OBX index of the merged exchange is carried out. It aims to test whether the efficiency of the securities market in the region of the merged stock exchange will be significantly improved. Finally, based on empirical analysis, the influence relationship of the merger of stock exchanges on market efficiency is obtained, the improvement of the overall efficiency of the securities market is also conducive to the development of tobacco enterprises, which is conducive to the improvement of the efficiency of the tobacco securities market.

RELATED RESEARCH

Since the 1990s, the communication technology revolution and competition have intensified, and the stock exchange has changed

from a membership system to a corporate system. The corporate system has become the development trend and mainstream, thereby providing conditions and opportunities for the merger and acquisition of the stock exchange. Historically, various forms of mergers and acquisitions, restructuring, and business innovation have emerged on the stock exchange since 1998. Moreover, under the influence of globalization, the merger of stock exchanges has contributed to the development of international financial markets. Nielsson U⁸ found that the benefits of liquidity asymmetry had a significant positive impact on large listed companies with overseas operations through the merger of the Amsterdam, Brussels, Lisbon, and Paris exchanges. Enderlein⁹ believed that through the merger of exchanges, economies of scale would be generated, which would reduce transaction costs and increase liquidity. Espinosa Méndez¹⁰, Choi¹¹, Charles¹² found that exchange mergers and acquisitions had an effect on raising stock yields, increasing the interdependence between mergers and acquisitions and exchanges, but reducing the market risk of investment diversification.

At present, most scholars study the efficiency of security market based on the efficient market theory advanced by Eugene Fama¹³, which mainly studies the reaction degree of securities price to market information and the random walk of securities price. Hovdahl Christian¹⁴ believed that the Norwegian exchange had signs of market inefficiency through modeling and analysis of AR and EGARCH. By using OBX total return index, OSEAX all share index, and OSESX small cap stock index, Yavrumyan and Evgenia⁶ concluded that all the three were weak markets, and OSESX may be a weak market caused by overpriced market transactions.

Walayet Khan and Joao Paulo Vieito³ were the first to study the impact of stock exchange mergers and acquisitions on market efficiency as the research on the impact of stock exchange mergers and acquisitions deepened. Based on the efficient market hypothesis and combined with

previo

us efficient market test methods, empirical analysis methods of serial correlation test, unit root test, multi-period variance ratio test, and Wright's rank and sign were adopted. It was found that Lisbon Stock Exchange was in a weak market before the merger of PAN-European Stock Exchange and the market efficiency of Lisbon Stock Exchange had a tendency to improve after the merger. Later, Siu Tung Ho⁴ analyzed the merger of four exchanges in Brussels, Amsterdam, Paris, and Lisbon by Pan-European Stock Exchange. The mean variance, CAPM statistics, multiple variance ratio tests, run tests, grade and sign tests, and random walk methods were adopted, and the market efficiency of the four stock exchanges was tested. The improvement of market efficiency in developing Lisbon was significant while the improvement of efficiency in the other three exchanges was limited. Shawing Yang⁵ analyzed the merger of the Surabaya Stock Exchange and the Jakarta Stock Exchange. It was found that the market efficiency of companies with small market capitalization improved significantly, while the market efficiency of companies with high market capitalization and non-financial companies was reduced by the entry of foreign capital to some extent.

There are few studies on tobacco stock market. John C. Beghin and C. A. Knox Lovell¹⁵ analyzed the international trade and domestic market efficiency effects of physical domestic content requirement in the Australian tobacco leaf growing and cigarette manufacturing industries. O'Leary and Christopher¹⁶. Analyzed the vast potential for tobacco legal fee securitization, Brown landed a lucrative United States tobacco industry legal fee securitization mandate, boosting its bid to dominate the asset-backed securities market. Levy D T and et al¹⁷. Through the analysis of the American tobacco industry, it is found that although tobacco companies improve their operation level through market forces, the market changes are diversified, and understanding the market structure is helpful for the government to formulate regulatory policies. Davis, KC and et

al¹⁸. By examining the influence of tax parity policy on domestic cigarette trafficking in three US cities, the smuggling rate of cigarettes is calculated. It is found that the policy may reduce domestic cigarette trafficking, and the policy of increasing tax gap will increase non-local cigarette consumption. Megan Little¹⁹. The study found that a significant increase in tobacco taxes in Georgia did not directly lead to an increase in illicit tobacco's market share, suggesting the importance of balancing tobacco product taxes to maximize public health benefits.

At present, there are few studies on the impact of exchange merger. However, the merger of the Norwegian Stock Exchange by the Pan-European Stock Exchange is a recent occurrence with strong timeliness and research significance, which is different from previous scholars' major macro analysis of the overall index. The author analyzes the specific situation of listed companies based on the micro index composition, and makes a close connection between exchange mergers and acquisitions and market efficiency, to make the empirical analysis closer to the real situation. Based on the existing research, the objective factors behind the successful merger of transnational stock exchanges are explored. In the end, conclusions are drawn on the market efficiency of the exchange merger, and the inspiration for the improvement of efficiency of tobacco securities market, which provides necessary reference for tobacco enterprises to finance in the securities market. It benefits from the improvement of overall efficiency of the securities market, which is transferred to the improvement of efficiency of tobacco securities market, which will be a new exploration direction of the efficiency of tobacco securities market.

$$\frac{[RSS_r - (RSS_1 + RSS_2)]/[T - k - 1 - (n_1 - k - 1 + n_2 - k - 1)]}{(RSS_1 + RSS_2)/(n_1 - k - 1 + n_2 - k - 1)}$$

That is,

$$F = \frac{[RSS_r - (RSS_1 + RSS_2)]/(k+1)}{(RSS_1 + RSS_2)/(T-2K-2)} F(K+1, T-2K-2).$$

T is the total sample size, n1 is the first sub-

EMPIRICAL ANALYSIS

The following relatively mature and highly accepted empirical methods are adopted to test the efficient market hypothesis. In the weak-form efficient market test, the time series independence test uses the OLS regression test, and then the Chow test is used based on that. The security price random walk test uses the single root test, that is the KPSS test.

Time Series Independence Test

For the time series independence test of securities prices, the following empirical method is used. The serial correlation coefficient test is widely used to test the relationship between current returns and previous returns. If no significant autocorrelation is found, then, the sequence is considered to follow a random walk.

OLS regression test:

OLS regression is adopted to study the explanatory power of the OBX-20 index in terms of the change in the return of each component stock. For the regression analysis of the index, the daily return rate of the security is taken as the dependent variable, and the daily return rate of the market index is the independent variable.

Chow test:

Based on OLS regression, Chow test is performed on the data. In time series analysis, Chow test is commonly used to test the existence of structural changes. Therefore, Chow test is performed to test whether there are structural changes after the merger of stock exchanges. This test is mainly carried out through EVIEWS, and the Chow Test statistic test structure is as follows.

sample size, n2 is the second sub-sample size, K is the number of explanatory variables summarized by the regression model, RSS is the residual sum of squares, and the Chow test obeys the degrees of freedom K and T-2K-2 F distribution.

Random Walk Model

According to the theory of the efficient market hypothesis, if the securities market is a weakly efficient market, then, the fluctuation of the securities price follows the random walk model. According to the random walk theory, the future security price is more difficult to predict than the path of cumulative random numbers. The advantage of random walk is to solve the dependence of the information obtained by the conditional mean of the price change at time t of the martingale. In addition, the dependence of higher conditional moments on price changes is also resolved (ie: variance, skewness, and kurtosis). Therefore, the random walk process assumes that the price change of a certain security in period $t+1$ has nothing to do with that in period t . Based on which, investors can't use the past securities prices of a listed company to predict future price trends. Scholars such as Lo & MacKinlay²⁰ defined three different types of random walk models, which are as follows.

Independent balanced distribution (random walk model I):

It is the most restrictive model and requires independent and balanced distribution (IID) of security price changes.

$$P_t = \mu + P_{t-1} + \varepsilon_t \quad \varepsilon_t \sim IID(0, \sigma^2) \quad (2)$$

In equation (2), μ is the change (drift) of the security price.

ε_t is independent and balanced distribution, mean 0 and variance σ^2 (white noise sequence).

Assuming that the increment is not related to any non-linear increment of the function, then, there is equation (3).

$$E \left[\frac{P_t}{P_0} \right] = P_0 + \mu_t \quad \text{and} \quad Var \left[\frac{P_t}{P_0} \right] = \sigma^2 \quad (3)$$

Independent increment (random walk model II):

In the second random walk model, the error term condition with the same distribution is not imposed to restrict the model. Therefore, this model allows unconditional heteroscedasticity, and the expected return probability will change over

time. Security prices must be uncorrelated with time fluctuations and tends not to be independent of time fluctuations but to produce volatility clusters. As a result, the second random walk model represents financial market behavior more realistically than the first.

Irrelevant increment (random walk model III):

Compared with model I and model II, the third random walk model has less restrictive conditions, and it relaxes the error term of independent and balanced distribution of price changes (IID).

One of the core points of the random walk theory is the mean regression model of stock returns. In other words, if the price of a stock can be mean reverting, it can predict future returns. Since stocks move in a systematic pattern, price change depends on past prices.

For the random walk test of security prices, the following empirical methods are used.

Unit root test

The existence of unit root (unstationary) of a sequence is the prerequisite for the sequence to meet the random walk. Commonly used unit root test methods are ADF (Augmented Dickey-Fuller) test, PP (Phillips-Person) test, and KPSS (Kwiatkowski, Phillips, Schmidt, and Shin) test.

As the ADF single root test does not consider whether the residuals have self-correlation and heterogeneous variation. The PP single-root test takes into account the possible self-correlation and heterogeneous variation of the residuals. Therefore, the ADF estimation formula is modified by the method of no mother number, and it has the same progressive distribution as the original ADF. Therefore, KPSS (Kwiatkowski, Philips, Schmidt, and Shin²¹) test is adopted to test OBX-25 related companies. The KPSS function in Eviews is utilized for detection. The statistical test structure is as follows.

According to the KPSS test, a time series P_t can be decomposed as shown in equation (4).

$$P_t = \mu + \omega t + r_t + u_t \quad (4)$$

In equation (4) rt is a random walk process, ut is an interference term, and the one-sided LM (Lagrange Multiplier) statistic is as follows.

$$LM = T^{-2} \sum_{t=1}^T \frac{S_t^2}{S^2(l)} s \quad (5)$$

The letters in equation (5) are explained as follows.

$$S_t^2 = \sum_{i=1}^T e_i \quad (6)$$

$$S^2(l) = T^{-2} \sum_{t=1}^T e_t^2 + 2T^{-1} \sum_{s=1}^l w(s, l) \sum_{t=s+1}^T e_t e_{t-s} \quad (7)$$

The sample size is T , e_i is the residual error of St on the intercept term and time trend regression, $w(s, l)$ is the variable weight function corresponding to different spectral windows, and Bartlett Window is selected for KPSS.

Based on the above basis, empirical analysis is conducted to test whether the merger of stock exchanges improves market efficiency. Finally, summary and conclusion are made, and some

conclusions and suggestions with practical reference value are put forward.

EMPIRICAL ANALYSIS OF MARKET EFFICIENCY BEFORE AND AFTER EXCHANGE MERGER

Sample Selection

The sample is selected from 25 listed companies involved in the OBX-25 index. OBX-25 is an index in Oslo Stock Exchange, Norway. The index is subject to a six-month revision system, and it is composed of the 25 stocks with the highest liquidity in the Oslo Stock Exchange in the past six months. The sample used in this work is a company adjusted by Oslo Stock Exchange in June 2019. Since it can fully reflect the specific conditions of the 25 companies involved in the index before and after the merger of the stock exchange, their securities prices are consistent (Table 1).

Table 1
OBX Index Constituent Stocks

Symbol	Name	Sector	Weight%
EQNR	Equinor	Oil & Gas	18.79
DNB	DNB	Banks	13.76
TEL	Telenor	Telecommunication Services	12.75
MOWI	Mowi	Packaged Foods & Meats	9.12
YAR	Yara International	Agricultural Chemicals	6.58
ORK	Orkla	Packaged Foods & Meats	5.81
NHY	Norsk Hydro	Aluminum	4.27
GJF	Gjensidige Forsikring	Multi-line Insurance	3.31
STB	Storebrand	Life & Health Insurance	2.92
TOM	Tomra Systems	Environmental Services	2.86
AKERBP	Aker BP	Oil & Gas Exploration & Production	2.41
SUBC	Subsea 7	Oil & Gas Equipment & Services	2.39
TGS	TGS-NOPEC Geophysical	Oil & Gas Equipmen t& Services	2.23
BAKKA	Bakkafrost	Packaged Foods & Meats	2.04
SALM	SalMar	Packaged Foods & Meats	1.97
SCHA	Schibsted ser.A	Publishing	1.86
LSG	Lerøy Seafood Group	Packaged Foods & Meats	1.68
AKER	Aker	Multi-Sector Holdings	1.24
DNO	DNO	Oil & Gas Exploration & Production	0.92
NEL	NEL	Construction & Engineering	0.77
ELK	Elkem	Specialty Chemicals	0.66
PGS	Petrol Geo-serv	Oil & Gas Equipment & Services	0.52
BWO	BW Offshore Limited	Oil & Gas Equipment & Services	0.48
NAS	Norwegian Air Shuttle	Airlines	0.35
GOGL	Golden Ocean Group	Marine	0.3

Source: Oslo Stock Exchange

Data Selection

When data is selected, it should first consider the frequency and sample size of the data. Selecting low-frequency data for modeling may cause problems such as parameter estimation deviation and poor overall data stability, while selecting high-frequency data is prone to information uncertainty and coherence. In view of this, the daily closing price of the security price is selected for modeling, which can effectively avoid the influence of the above-mentioned low-frequency and high-frequency data.

According to data from Pan-European Stock Exchange on its official website, the cut-off point for the merger is July 4, 2019, the announcement date. If the deadline is the weekend, it will be

postponed to the nearest trading day. Ultimately, the continuity of the time series of securities prices is ensured. The comparison period is divided into three periods, one month, three months, and six months before and after the merger of the stock exchanges and they are labelled short period, medium period, and long period, respectively. The first short period is from June 4, 2019 to July 4, 2019 and the second is after the merger with the stock exchange, that is, from July 4, 2019 to August 5, 2019. The first medium period is from April 4, 2019 to July 4, 2019 and the second is after the merger with the stock exchange, that is, from July 4, 2019 to October 4, 2019. The first long period is from January 4, 2019 to July 4, 2019, and the second is after the merger with the stock exchange, that

is, from July 4, 2019 to January 4, 2020. Such classification also effectively avoids the impact of the new coronavirus in 2020 on the test. The data displayed in the data inspection, modeling, and the results of tables and figures in this article are all sourced from Eviews.

Efficient Market Test

After the merger of Pan-European Stock Exchange and Oslo Stock Exchange, Norway, the impact of the market efficiency of Oslo Stock Exchange is tested. Based on the research of relevant scholars, relevant model application and actual utility are extensively collected. For the efficient market hypothesis theory, OLS regression test and the Chow test²², are adopted in the time series independence test part.

Currently, there are two calculation methods for the market rate of return.

$$\text{Arithmetic rate of return: } R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (8)$$

$$\text{Geometric rate of return: } R_t = \ln \frac{P_t}{P_{t-1}} \quad (9)$$

P_t is the closing price of the securities on the trading day t , and P_{t-1} is the closing price of the securities on the $t-1$ trading day. The relative stock price changes of 25 companies traded on the OBX-25 index are calculated via the method of scholar Fama¹³.

P_t is the closing price of securities on the trading day, and P_{t-1} is the price of securities on the next trading day.

$$\begin{aligned} P & \text{ (change in stock price)} \\ &= \ln(P_t) - \ln(P_{t-1}) \end{aligned} \quad (10)$$

Such method calculates the geometric rate of return. It has mathematical advantages, which can simplify the calculation process and can reduce impact of potential heteroscedasticity. Related

scholars such as Walayet Khan³ and Siu Tung Ho⁴ carried out precedents for the operation of this method, which has practical utility for similar research and reduces the possibility of other potential errors.

Statistical Analysis of Data Features:

First, the log return time series of the Oslo Stock Exchange OBX-25 index is analyzed. The results of the time series analysis through Eviews are as follows.

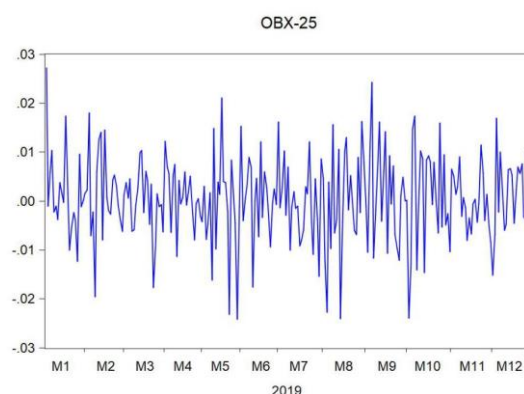


Figure 1 Time series chart of OBX-25 index return rate (comprehensive).

From Figure 1, the OBX-25 index return rate of Oslo Stock Exchange exhibits a phenomenon of volatility clusters. The volatility is large at certain times, and greater positive volatility occurs when there is a positive volatility, and similar situation occurs in negative fluctuations.

After that, the 25 constituent stocks of the OBX index are tested one by one for the normal distribution over the short period, medium period, and long period. The QQ chart is used for this purpose. The specific QQ charts are shown as follows.

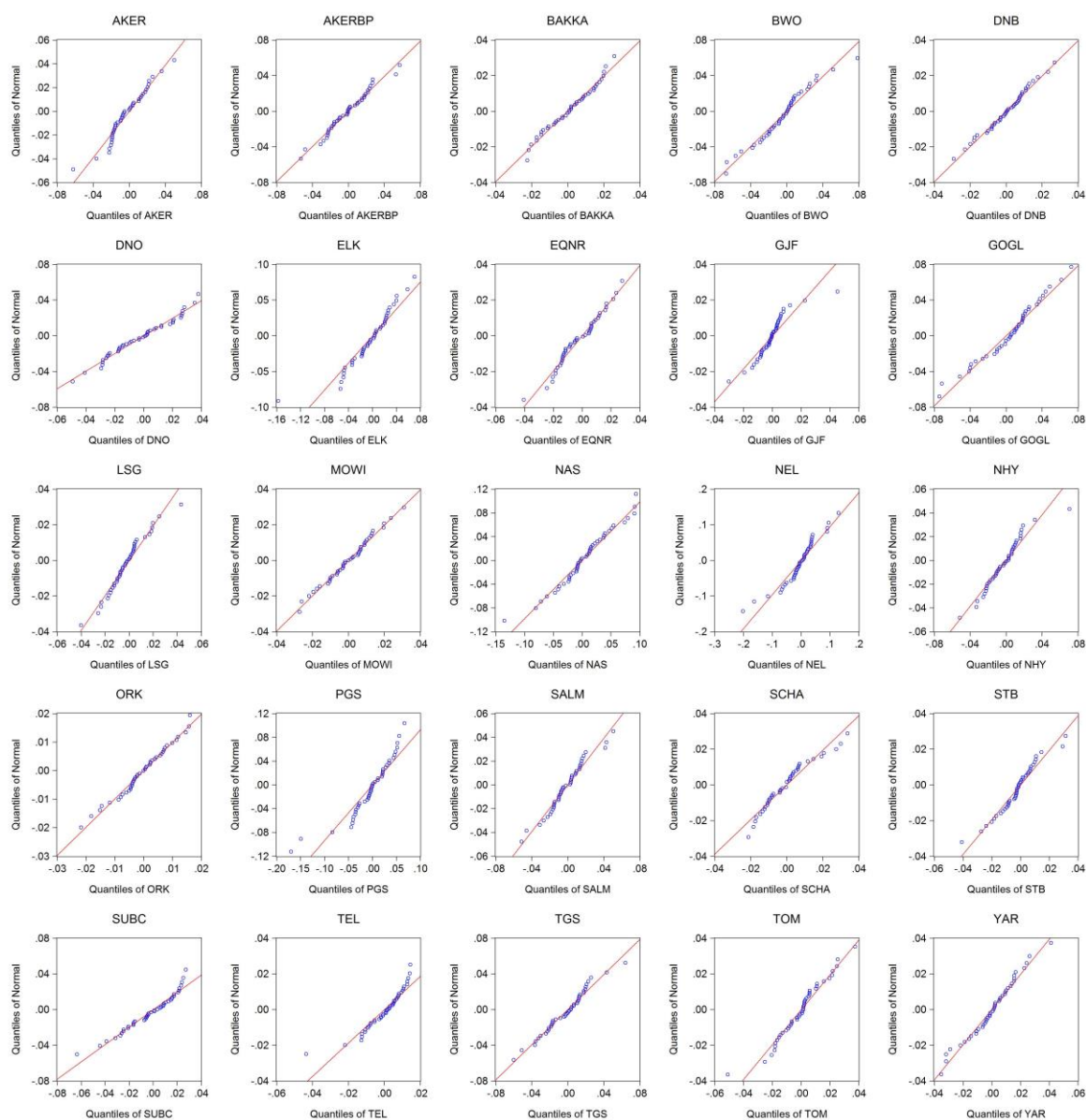


Figure 2 QQ chart before and after the merger of 25 companies (short period).

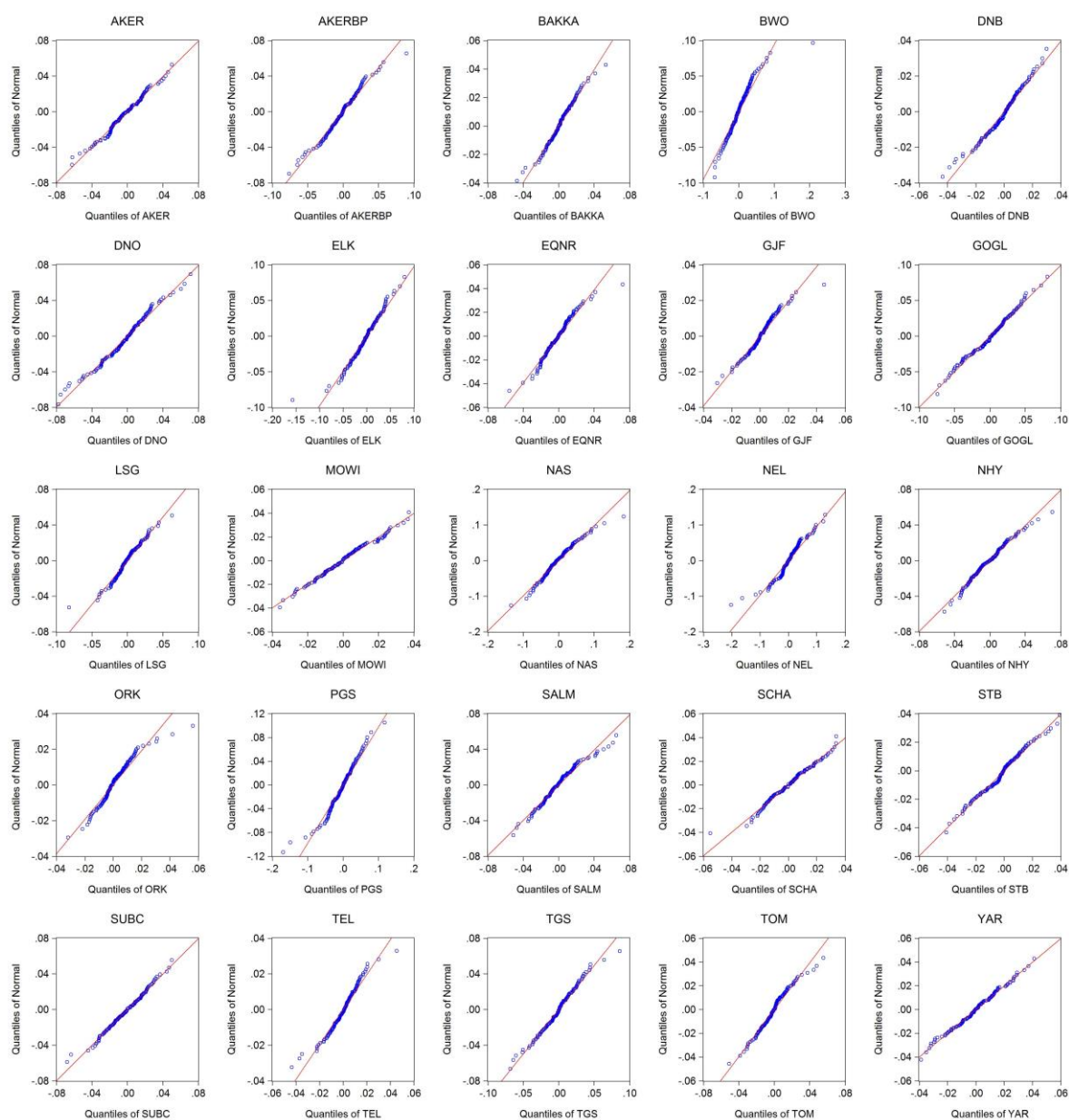


Figure 3 QQ chart before and after the merger of 25 companies (medium period).

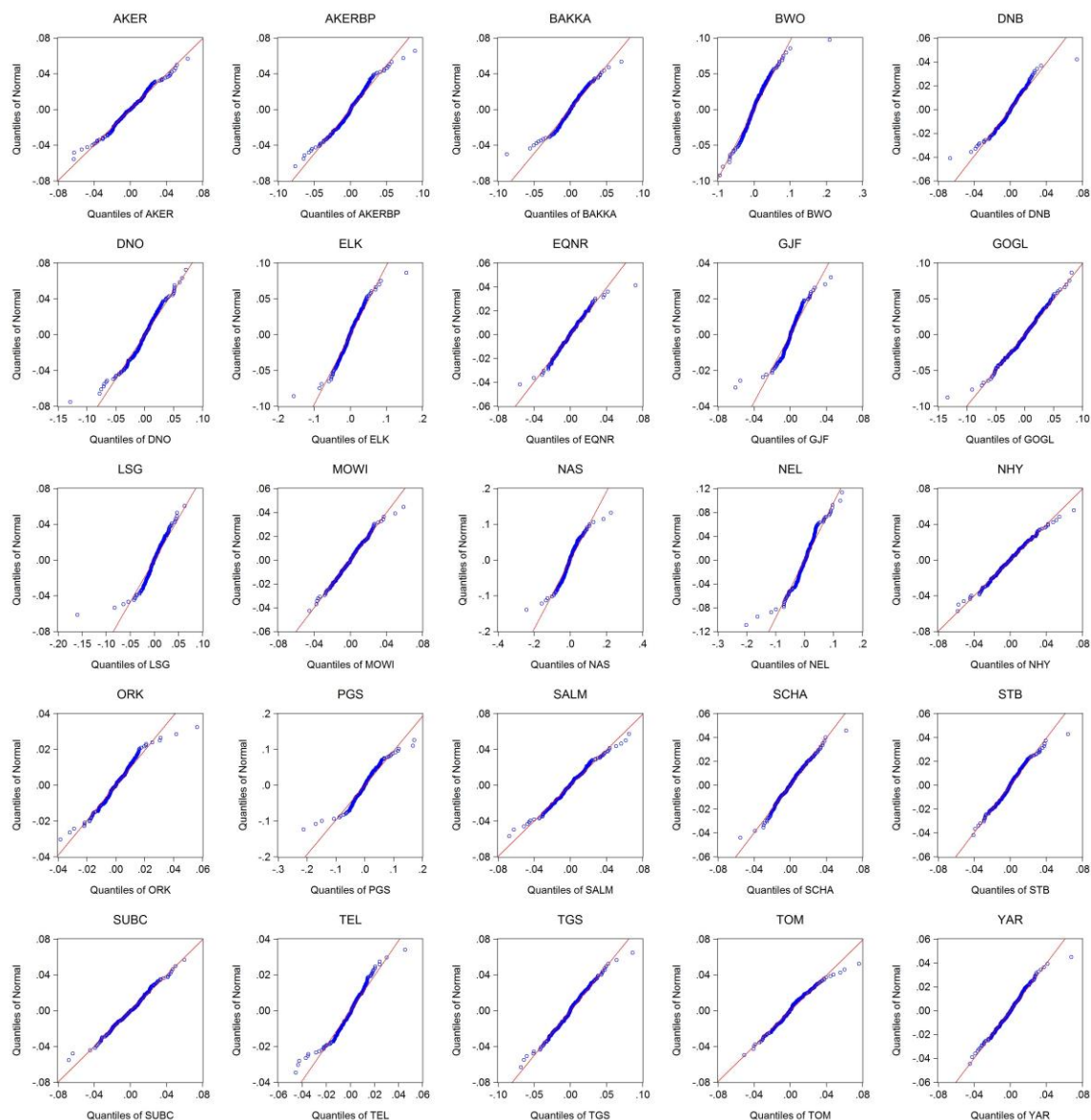


Figure 4 QQ chart before and after the merger of 25 companies (long period).

Figures 2-4 show that in the short, medium, and long periods, the stock returns of the 25 constituent stocks of the OBX-25 index have scattered points deviated from the regression line of the normal distribution and have the characteristics of thick-tail distribution, suggesting that the information in the securities market will cause violent fluctuations in the price of securities. Moreover, investors are not sufficiently sensitive to such information, the non-linear response of market participants to this information cannot be quickly reflected in the stock price. Therefore, the returns distribution of the 25

stocks do not follow the normal distribution, and all share an asymmetry and thick tail characteristics of the time series fluctuations of financial data.

Time Series Regression Analysis and Chow Test:

The single-factor market model is commonly used model for generating expected normal returns in a test of efficiency markets. such as Walayet Khan³ and Siu Tung Ho⁴ used this model for testing. The expected normal return generated by the model is compared with the realized return to estimate whether there will be abnormal returns in the securities market after the merger of the exchanges. To test the explanatory

power of the single-factor market model, the daily return rate of securities is taken as the dependent variable and the daily return rate of the market as the independent variable, to run time series regression (OLS regression) on the 25 listed companies involved in OBX-25. In addition, the Chow test is also adopted to analyze whether there is a structural break after the merger of Oslo Stock Exchange, that is, whether the impact of

the combined market return is significantly different before and after the merger. In this case, the null hypothesis represents a stable regression coefficient. If the null hypothesis is rejected, then there is a structural break in the data after the merger of the stock exchanges. The regression analysis of the daily returns of the OBX-25 index constituent stocks is shown as follows.

Table 2
Regression Analysis of Daily Stock Returns of the OBX-25 Index Constituent Stocks (Short Period)

Stock Code	weight (%)	Before the merger			After the merger			Full sample period		
		N	Adj R	Sig.	N	Adj R	Sig.	N	Adj R	Sig.
AKER	1.24	22	0.501	0.000	22	0.396	0.001	44	0.466	0.000
AKERBP	2.41	22	0.474	0.000	22	0.580	0.000	44	0.541	0.000
BAKKA	2.04	22	0.137	0.051	22	0.123	0.061	44	0.175	0.030
BWO	0.48	22	0.415	0.001	22	0.407	0.001	44	0.410	0.000
DNB	13.76	22	0.381	0.001	22	0.619	0.000	44	0.540	0.000
DNO	0.92	22	0.350	0.002	22	0.224	0.015	44	0.301	0.000
ELK	0.66	22	0.057	0.148	22	0.413	0.001	44	0.194	0.002
EQNR	18.79	22	0.733	0.000	22	0.555	0.000	44	0.642	0.000
GJF	3.31	22	-0.050	0.926	22	-0.013	0.401	44	-0.002	0.341
GUGL	0.3	22	0.210	0.019	22	0.087	0.099	44	0.213	0.001
LSG	1.68	22	0.014	0.267	22	0.136	0.051	44	0.092	0.026
MOWI	9.12	22	0.078	0.110	22	0.185	0.026	44	0.138	0.007
NAS	0.35	22	0.076	0.115	22	-0.050	0.965	44	0.006	0.267
NEL	0.77	22	-0.010	0.386	22	0.036	0.197	44	0.017	0.196
NHY	4.27	22	0.586	0.000	22	0.334	0.003	44	0.427	0.000
ORK	5.81	22	0.161	0.037	22	0.184	0.027	44	0.221	0.001
PGS	0.52	22	0.210	0.019	22	0.094	0.089	44	0.153	0.005
SALM	1.97	22	0.046	0.172	22	0.101	0.082	44	0.086	0.030
SCHA	1.86	22	0.041	0.184	22	0.167	0.033	44	0.123	0.011
STB	2.92	22	0.130	0.055	22	0.331	0.003	44	0.282	0.000
SUBC	2.39	22	0.473	0.000	22	0.274	0.007	44	0.377	0.000
TEL	12.75	22	0.006	0.300	22	0.027	0.222	44	0.042	0.097
TGS	2.23	22	0.462	0.000	22	0.511	0.000	44	0.512	0.000
TOM	2.86	22	0.098	0.085	22	-0.029	0.532	44	0.049	0.080
YAR	6.58	22	-0.027	0.515	22	0.076	0.114	44	0.055	0.068

In Table 2, Adj R squared shows that in the short period, some stock returns have a weak explanatory power of securities returns, such as GJF (-0.2%) and NAS (0.6%). However, some have relatively high explanatory power, e.g., EQNR (64.2%), and AKERBP (54.1%). Although the models are different, the test results show that the rate of market return can't fully explain the changes in the rate of return of each security. As far the short period is concerned, the OBX-

25 index has good explanatory power for companies such as EQNR (oil and gas integration), AKERBP (oil and gas exploration and production), and DNB (financial services).

The explanatory power of the market model seems to decline after the merger of the stock exchanges in the short period, such as NHY (-25.2%) and SUBC (-19.83%). Approximately 44% of the stock returns experience declines in explanatory power. However, the explanatory power for certain stocks is increased, such as ELK

(35.6%), DNB (23.8%), and STB (20.06%). Approximately 56% of securities returns experience increases in explanatory power.

Therefore, from a short period perspective, the explanatory power of the market model after the merger is improved overall.

Table 3
Regression Analysis of Daily Stock Returns of the OBX-25 Index Constituent Stocks (Medium Period).

Stock Code	weight (%)	Before the merger			After the merger			Full sample period		
		N	Adj R	Sig.	N	Adj R	Sig.	N	Adj R	Sig.
AKER	1.24	59	0.474	0.000	66	0.658	0.000	125	0.578	0.000
AKERBP	2.41	59	0.416	0.000	66	0.600	0.000	125	0.517	0.000
BAKKA	2.04	59	0.159	0.001	66	0.120	0.003	125	0.143	0.000
BWO	0.48	59	0.165	0.001	66	0.258	0.000	125	0.227	0.000
DNB	13.76	59	0.419	0.000	66	0.578	0.000	125	0.517	0.000
DNO	0.92	59	0.340	0.000	66	0.528	0.000	125	0.453	0.000
ELK	0.66	59	0.075	0.030	66	0.451	0.000	125	0.247	0.000
EQNR	18.79	59	0.575	0.000	66	0.671	0.000	125	0.631	0.000
GJF	3.31	59	0.180	0.001	66	0.220	0.000	125	0.212	0.000
GOGL	0.3	59	0.210	0.000	66	0.329	0.000	125	0.270	0.000
LSG	1.68	59	0.028	0.107	66	0.123	0.002	125	0.081	0.001
MOWI	9.12	59	0.120	0.004	66	0.081	0.012	125	0.105	0.000
NAS	0.35	59	0.171	0.000	66	0.031	0.083	125	0.083	0.001
NEL	0.77	59	0.058	0.037	66	0.264	0.000	125	0.128	0.000
NHY	4.27	59	0.497	0.000	66	0.458	0.000	125	0.473	0.000
ORK	5.81	59	-0.008	0.465	66	0.039	0.061	125	0.021	0.057
PGS	0.52	59	0.209	0.000	66	0.367	0.000	125	0.290	0.000
SALM	1.97	59	0.033	0.089	66	0.086	0.009	125	0.061	0.003
SCHA	1.86	59	0.051	0.050	66	0.129	0.002	125	0.091	0.000
STB	2.92	59	0.218	0.000	66	0.465	0.000	125	0.397	0.000
SUBC	2.39	59	0.581	0.000	66	0.498	0.000	125	0.533	0.000
TEL	12.75	59	0.070	0.024	66	0.114	0.003	125	0.096	0.000
TGS	2.23	59	0.305	0.000	66	0.576	0.000	125	0.097	0.000
TOM	2.86	59	0.161	0.001	66	0.059	0.030	125	0.446	0.000
YAR	6.58	59	0.260	0.000	66	0.251	0.000	125	0.259	0.000

From Table 3, Adj R shows that the explanatory power of part of the market return in the medium period is relatively small, for example, ORK is 2.1% and SALM is 6.1%. Some have better explanatory power, such as EQNR of 63.1% and AKER of 57.8%. Although the models are different, the test results show that the market rate of return can't fully explain the changes in the rate of return of each security, and may have other influencing factors. From the results, the market explanatory power of medium period OBX-25 has greater explanatory power for companies such as EQNR (oil and gas integration), AKER (oil and gas equipment and services), and SUBC (oil and gas equipment and services).

From the perspective of changes in explanatory power before and after the merger of stock exchanges, in the medium period, the market explanatory power declines in certain securities returns, such as NAS (-14%) and TOM (-10.2%). Approximately 28% of the securities return rate declines in explanatory power. However, the explanatory power of certain securities is increased, such as ELK (37.56%) and TGS (27.1%). Approximately 72% of the explanatory power of securities return rate increases. Therefore, in the medium period perspective, the overall explanation of the return on securities after the merger is improved significantly.

Table 4
Regression Analysis of Daily Income of Listed Companies Involved in the OBX-25 Index (Long Period).

Stock Code	weight (%)	Before the merger			After the merger			Full sample period		
		N	Adj R	Sig.	N	Adj R	Sig.	N	Adj R	Sig.
AKER	1.24	123	0.396	0.000	127	0.579	0.000	250	0.489	0.000
AKERBP	2.41	123	0.447	0.000	127	0.567	0.000	250	0.506	0.000
BAKKA	2.04	123	0.099	0.000	127	0.135	0.000	250	0.116	0.000
BWO	0.48	123	0.246	0.000	127	0.248	0.000	250	0.250	0.000
DNB	13.76	123	0.287	0.000	127	0.536	0.000	250	0.370	0.000
DNO	0.92	123	0.332	0.000	127	0.342	0.000	250	0.338	0.000
ELK	0.66	123	0.123	0.000	127	0.377	0.000	250	0.230	0.000
EQNR	18.79	123	0.599	0.000	127	0.581	0.000	250	0.584	0.000
GJF	3.31	123	0.112	0.000	127	0.181	0.000	250	0.151	0.000
GOGL	0.3	123	0.207	0.000	127	0.221	0.000	250	0.212	0.000
LSG	1.68	123	0.085	0.001	127	0.138	0.000	250	0.117	0.000
MOWI	9.12	123	0.140	0.000	127	0.154	0.000	250	0.150	0.000
NAS	0.35	123	0.034	0.022	127	0.045	0.009	250	0.042	0.001
NEL	0.77	123	0.081	0.001	127	0.228	0.000	250	0.135	0.000
NHY	4.27	123	0.377	0.000	127	0.388	0.000	250	0.382	0.000
ORK	5.81	123	0.047	0.009	127	0.035	0.019	250	0.045	0.001
PGS	0.52	123	0.171	0.000	127	0.240	0.000	250	0.206	0.000
SALM	1.97	123	0.103	0.000	127	0.150	0.000	250	0.126	0.000
SCHA	1.86	123	0.164	0.000	127	0.144	0.000	250	0.156	0.000
STB	2.92	123	0.265	0.000	127	0.396	0.000	250	0.336	0.000
SUBC	2.39	123	0.473	0.000	127	0.459	0.000	250	0.467	0.000
TEL	12.75	123	0.113	0.000	127	0.062	0.003	250	0.089	0.000
TGS	2.23	123	0.375	0.000	127	0.499	0.000	250	0.434	0.000
TOM	2.86	123	0.135	0.000	127	0.092	0.000	250	0.112	0.000
YAR	6.58	123	0.353	0.000	127	0.207	0.000	250	0.275	0.000

From Table 4, Adj R shows that the explanatory power of part of the market's return rate in the long period is relatively small for the securities return rate, such as 4.2% for NAS and 4.5% for ORK. For those with relatively better explanatory power, EQNR is 58.4%, AKERBP is 50.6%. Although the models are different, the test results show that the market rate of return can't fully explain the changes in the rate of return of each security, and there may be other influencing factors. From the results, the market explanatory power of long period OBX-25 has greater explanatory power for companies such as EQNR (oil and gas integration), AKERBP (oil and gas exploration and production), and AKER (oil

and gas equipment and services).

From the perspective of the changes in explanatory power before and after the merger of stock exchanges, in the long period, the market explanatory power declines in the return rate of certain securities, such as YAR (-14.6%) and TEL (-5.1%). Approximately 28% of the securities return rate declines in explanatory power. However, the explanatory power of certain securities is increased, such as ELK (25.4%) and DNB (24.8%). Approximately 72% of the securities return rate increases in explanatory power. Therefore, from a long period perspective, the overall explanation of the return on securities after the merger is improved significantly.

After the time series regression, the Chow test is performed on the short, medium, and long, respectively, to analyze whether there is a

structural breakthrough after the merger of the stock exchange. The test results are as follows.

Stock Code	Short period			Medium period			long period		
	F-Satistic	Sig.	NHR	F-Satistic	Sig.	NHR	F-Satistic	Sig.	NHR
AKER	0.390	0.679	NO	1.246	0.291	NO	0.115	0.892	NO
AKERBP	0.411	0.666	NO	0.594	0.554	NO	0.155	0.857	NO
BAKKA	0.041	0.956	NO	0.235	0.791	NO	0.179	0.837	NO
BWO	0.575	0.567	NO	0.483	0.618	NO	0.099	0.906	NO
DNB	1.134	0.332	NO	0.554	0.576	NO	4.140	0.017	YES
DNO	0.301	0.742	NO	0.697	0.500	NO	1.295	0.276	NO
ELK	0.584	0.566	NO	1.667	0.193	NO	1.030	0.360	NO
EQNR	0.024	0.976	NO	1.438	0.241	NO	1.780	0.171	NO
GJF	0.232	0.794	NO	0.234	0.792	NO	0.813	0.445	NO
GOGL	1.499	0.236	NO	0.271	0.763	NO	0.524	0.593	NO
LSG	0.189	0.829	NO	0.266	0.767	NO	0.469	0.626	NO
MOWI	0.549	0.582	NO	0.232	0.793	NO	0.039	0.962	NO
NAS	0.139	0.870	NO	0.401	0.671	NO	1.233	0.293	NO
NEL	0.085	0.919	NO	0.070	0.933	NO	0.154	0.858	NO
NHY	0.047	0.955	NO	0.755	0.472	NO	0.855	0.427	NO
ORK	0.460	0.634	NO	0.324	0.724	NO	0.113	0.893	NO
PGS	0.734	0.487	NO	0.928	0.398	NO	0.286	0.752	NO
SALM	0.217	0.801	NO	0.033	0.967	NO	0.201	0.818	NO
SCHA	0.137	0.873	NO	0.828	0.440	NO	0.438	0.646	NO
STB	0.890	0.419	NO	1.180	0.311	NO	0.944	0.391	NO
SUBC	0.195	0.824	NO	0.656	0.521	NO	0.566	0.568	NO
TEL	0.032	0.968	NO	0.310	0.734	NO	1.493	0.227	NO
TGS	0.004	0.996	NO	0.050	0.951	NO	0.110	0.895	NO
TOM	0.269	0.765	NO	0.502	0.601	NO	0.752	0.473	NO
YAR	0.703	0.501	NO	0.298	0.742	NO	2.007	0.137	NO

From Table 5, after processing of the short period based on F statistics there are GJF (financial services), NAS (aviation), NEL (engineering construction), TEL (communication services), TOM (waste management services), and YAR (chemical manufacturing) that pass the null hypothesis. It shows that there is no sudden change in the securities return rate of the company in the short period after the merger, which shows that the market return explains the securities return.

After processing of the medium period based on F statistics, GJF (financial services), NAS (aviation), NEL (engineering construction), TEL (communication services), TOM (waste management services), and YAR (chemical manufacturing) pass the original hypothesis. It

shows that there is no sudden change in the securities return rate of the company in the medium period after the merger, indicating that the market return basically explains the securities return.

After processing of the long period based on F statistics, only DNB (financial services) company rejects the original hypothesis and a structural mutation occurs, and the rest pass the original hypothesis. Therefore, from a long period perspective, the explanatory power of market returns to securities returns is decreased.

In summary, the market earnings of all companies in the short period after the merger of the stock exchange can effectively explain their securities earnings, which prevents investors from obtaining excess returns, indicating that market

efficiency greatly improves in a short period of time. In the medium period, the situation is similar to that of short one, and there is no structural breakthrough. However, the overall significance test average is decreased (the significance level increases). It explains that the impact of the merger of stock exchanges is weakened over time and the improvement of market efficiency. From a long-period perspective, it confirms the trend of the medium period. The mean value of the significance test is lower than that of the medium period (the significance level increases), and there is a structural breakthrough in a company in the

Chow test. Market efficiency is returned to its original state as the merger time of stock exchanges is lengthened, and it fails to effectively and long improve market efficiency.

Random Walk Model Test:

In the efficient market hypothesis theory, whether the security price follows a random walk is an important prerequisite. As the ADF test may have high-order problems, the PP test is needed to make up the relevant area. Therefore, only KPSS test is used to test the companies involved in OBX-25.

The KPSS inspection is as follows.

Stock Code	Full sample period *		Before the merger *		After the merger *	
	LM-Stat.	NHR	LM-Stat.	NHR	LM-Stat.	NHR
AKER	0.151	NO	0.203	NO	0.090	YES
AKERBP	0.112	YES	0.146	NO	0.085	YES
BAKKA	0.143	NO	0.201	NO	0.175	NO
BWO	0.161	NO	0.500	NO	0.229	NO
DNB	0.072	YES	0.249	NO	0.127	NO
DNO	0.048	YES	0.500	NO	0.084	YES
ELK	0.075	YES	0.086	YES	0.123	NO
EQNR	0.077	YES	0.423	NO	0.091	YES
GJF	0.084	YES	0.196	NO	0.644	NO
GOGL	0.126	NO	0.267	NO	0.143	NO
LSG	0.182	NO	0.091	YES	0.178	NO
MOWI	0.138	NO	0.094	YES	0.095	YES
NAS	0.071	YES	0.074	YES	0.075	YES
NEL	0.156	NO	0.500	NO	0.224	NO
NHY	0.114	YES	0.089	YES	0.127	NO
ORK	0.039	YES	0.112	YES	0.167	NO
PGS	0.064	YES	0.126	NO	0.110	YES
SALM	0.211	NO	0.083	YES	0.161	NO
SCHA	0.058	YES	0.133	NO	0.167	NO
STB	0.063	YES	0.211	NO	0.137	NO
SUBC	0.053	YES	0.397	NO	0.144	NO
TEL	0.138	NO	0.083	YES	0.500	NO
TGS	0.167	NO	0.138	NO	0.156	NO
TOM	0.115	YES	0.065	YES	0.058	YES
YAR	0.088	YES	0.500	NO	0.139	NO

* Critical Value: 1%: 0.216; 5%: 0.146; 10%: 0.119.

Table 6 shows that through the short period OBX-25's time series of returns of listed companies, the KPSS test results show that, for the entire stock exchange merger cycle, the test results of ten listed companies reject the original

hypothesis. SALM (food processing), LSG (food processing), NAS (aviation), and BWO (oil and gas services and facilities) follow random walks. Before the merger of the stock exchange, only nine companies, including TOM (service, management service), NAS (aviation), and TEL

(communication service) don't follow the random walk in their return sequence. The securities prices of other companies follow a random walk. After the merger on the stock exchange, several companies such as ELK (chemical manufacturing), LGS (food processing), and TEL

(communication services) go from being stable to following a random walk. Only eight securities prices don't follow the random walk. Therefore, from a short period perspective, the merger of stock exchanges improves market efficiency.

Table 7
KPSS Test Results of Listed Companies Involved in the OBX-25 Index (Medium Period).

Stock Code	Full sample period *		Before the merger *		After the merger *	
	LM-Stat.	NHR	LM-Stat.	NHR	LM-Stat.	NHR
AKER	0.068	YES	0.078	YES	0.156	NO
AKERBP	0.055	YES	0.082	YES	0.086	YES
BAKKA	0.099	YES	0.053	YES	0.190	NO
BWO	0.081	YES	0.086	YES	0.112	YES
DNB	0.064	YES	0.123	NO	0.093	YES
DNO	0.047	YES	0.085	YES	0.090	YES
ELK	0.060	YES	0.121	NO	0.098	YES
EQNR	0.078	YES	0.080	YES	0.154	NO
GJF	0.092	YES	0.086	YES	0.071	YES
GOGL	0.083	YES	0.175	NO	0.118	YES
LSG	0.036	YES	0.108	YES	0.071	YES
MOWI	0.045	YES	0.070	YES	0.082	YES
NAS	0.060	YES	0.124	NO	0.069	YES
NEL	0.064	YES	0.148	NO	0.090	YES
NHY	0.053	YES	0.103	YES	0.109	YES
ORK	0.067	YES	0.099	YES	0.090	YES
PGS	0.027	YES	0.035	YES	0.046	YES
SALM	0.063	YES	0.134	NO	0.064	YES
SCHA	0.086	YES	0.077	YES	0.106	YES
STB	0.064	YES	0.068	YES	0.099	YES
SUBC	0.042	YES	0.034	YES	0.093	YES
TEL	0.027	YES	0.085	YES	0.053	YES
TGS	0.056	YES	0.077	YES	0.111	YES
TOM	0.070	YES	0.079	YES	0.500	NO
YAR	0.037	YES	0.046	YES	0.072	YES

* Critical Value: 1%: 0.216; 5%: 0.146; 10%: 0.119.

Data source: EvIEWS output results.

Table 7 shows that through the time series of the return rate of listed companies involved in the medium period OBX-25, the KPSS test results show that, in the entire stock exchange merger cycle, they all accept the null hypothesis, that is, the rejection of random walks. Before the merger of the stock exchange, only six companies, including GOGL (water transportation), NEL (engineering construction), and SALM (food processing), follow the random walk in the sequence of returns. The securities prices of other companies don't follow a random walk. After the

merger of the stock exchange, the four companies AKER (oil and gas equipment and services), BAKKA (food processing), EQNR (petroleum gas), and TOM (waste management services) go from being stable to following random walks. None of the other companies follow a random walk. Therefore, from a short period perspective, the merger of stock exchanges improves the market efficiency, but the efficiency of the improvement is lower compared with that of short period perspective.

Table 8
KPSS Test Results of Listed Companies Involved in the OBX-25 Index (Long Period).

Stock Code	Full sample period *		Before the merger *		After the merger *	
	LM-Stat.	NHR	LM-Stat.	NHR	LM-Stat.	NHR
AKER	0.224	NO	0.139	NO	0.062	YES
AKERBP	0.256	NO	0.123	NO	0.040	YES
BAKKA	0.055	YES	0.142	NO	0.059	YES
BWO	0.478	NO	0.049	YES	0.107	YES
DNB	0.065	YES	0.131	NO	0.082	YES
DNO	0.107	YES	0.071	YES	0.045	YES
ELK	0.117	YES	0.054	YES	0.036	YES
EQNR	0.108	YES	0.062	YES	0.101	YES
GJF	0.056	YES	0.064	YES	0.075	YES
GOGL	0.063	YES	0.070	YES	0.045	YES
LSG	0.025	YES	0.090	YES	0.037	YES
MOWI	0.036	YES	0.088	YES	0.045	YES
NAS	0.053	YES	0.090	YES	0.058	YES
NEL	0.030	YES	0.059	YES	0.077	YES
NHY	0.038	YES	0.061	YES	0.074	YES
ORK	0.049	YES	0.069	YES	0.066	YES
PGS	0.143	NO	0.042	YES	0.048	YES
SALM	0.026	YES	0.078	YES	0.034	YES
SCHA	0.066	YES	0.091	YES	0.052	YES
STB	0.157	NO	0.039	YES	0.115	YES
SUBC	0.138	NO	0.031	YES	0.044	YES
TEL	0.060	YES	0.061	YES	0.045	YES
TGS	0.070	YES	0.072	YES	0.061	YES
TOM	0.123	NO	0.038	YES	0.064	YES
YAR	0.025	YES	0.040	YES	0.038	YES

* Critical Value: 1%: 0.216; 5%: 0.146; 10%: 0.119.

Table 8 shows that through the long OBX-25's time series of returns of listed companies, the KPSS test results show that, for the entire stock exchange consolidation cycle, some companies such as: AKER (oil and gas equipment and services), AKERBP (oil and gas operations) and BWO (oil well services and equipment) follow random walks, while the rest refuse to walk randomly. Before the merger of the stock exchange, only four companies, including AKER (oil and gas equipment and services), AKERBP (oil and gas operations), and BAKKA (food processing), follow a random walk in the sequence of returns. The securities prices of other companies don't follow a random walk. After the merger of the stock exchange, the companies don't follow a random walk. Therefore, from a long period perspective, the merger of stock exchanges has little effect on market efficiency, which is even lower than that in the medium period.

Taken together, the KPSS test results show that the merger of stock exchanges greatly improves the market efficiency in a short period of time, and the time series of returns of some securities shows an unstable characteristic, but it is not obvious. In the medium period perspective, the consolidation of stock exchanges reduces market efficiency, and the effect is lower than that in the short period. From a long-period perspective, the effect of improving market efficiency is further declined based on that of the medium period. Therefore, for the listed companies involved in the OBX-25 index, the time series of securities returns under the KPSS test shows that although the merger of stock exchanges improves the market efficiency in the short term, the improvement of market efficiency is limited as time increases.

CONCLUSION

In summary, from the perspective of the explanatory power of market return rates to securities return rates, the merger of Pan-European Stock Exchange with Oslo Stock Exchange, Norway significantly improves the market efficiency. The Norwegian stock market applies the weak efficient market in the efficient market hypothesis, and the merger of stock exchanges can indeed improve market efficiency. However, from the analysis of the random walk model, it is found that under the KPSS test, the merger of securities transactions improves market efficiency. As time increases and decreases, the validity decreases. Therefore, the merger of exchanges has a positive effect on market efficiency. To a certain extent, the merger of the stock exchanges improves the efficiency of the Norwegian stock market.

With the merger of the stock exchange market, the efficiency of the tobacco securities market will be improved. The securitization of the tobacco industry will not only improve the financing efficiency and scale of tobacco enterprises, but also greatly help tobacco companies in the securitization of legal fees. Data show that in the second half of the 20th century, tobacco companies ranked first in the S&P 500 index, with annual returns of nearly 20%. So by the securities exchange consolidation by raising the efficiency of stock market, will further facilitate the tobacco companies financing convenience, under the new era, the society for tobacco control strength increasing, by tobacco consumption tax and tobacco control measures, for the traditional tobacco consumption further weakened, now e-cigarettes as emerging market, according to the National Academies of Sciences, Engineering, and Medicine study found that e-cigarettes are far less harmful than traditional cigarettes. National Institute for Medical Research funded a large clinical trial. The clinical trial, involving nearly 900 participants, found that e-cigarettes were twice as effective as nicotine replacement therapy (NRT) in helping smokers quit. Tobacco compa

nies through the efficient tobacco securities market to finance, it will help to improve the financing cost of tobacco enterprises, accelerate the gradual transformation and upgrading of traditional tobacco, and further reduce the legal risks for social public responsibility.

Data Availability Statement

All data comes from the Yahoo Finance database.

Acknowledgements

The authors are grateful for the suggestions and guidance received from Professor Adrian (Wai Kong) Cheung, Dean of the Faculty of Finance of the City University of Macau.

Conflicts of Interest

These no potential competing interests in our paper. And all authors have seen the manuscript and approved to submit to your journal. We confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

Author Declaration

This research is not funded by any organization related to tobacco production.

References

1. Nielsson U. Stock exchange merger and liquidity: The case of Euronext. *Journal of Financial Markets*. 2009; 12(2):229-267.
doi: 10.1016/j.finmar.2008.07.002
2. Olivares-Caminal I K. Lessons from the Recent Stock Exchange Merger Activity. *Journal of Competition Law & Economics*. 2008; 4(3):837-869.
doi: 10.1093/joclec/nhn002
3. Khan W, Vieito J P. Stock exchange mergers and weak form of market efficiency: The case of Euronext Lisbon. *International Review of Economics & Finance*. 2012; 22(1):173-189.
doi: 10.1016/j.iref.2011.09.005
4. Ho S, Lean H H, Vieito J P, et al. Euronext Stock Exchange Merger and Market Efficiency. *Social Science Electronic Publishing*. 2013; 1:28-51.

doi: 10.2139/ssrn.2209198

5. Yang A S, Pangastuti A. Stock market efficiency and liquidity: The Indonesia Stock Exchange merger. *Research in International Business & Finance*. 2016; 36(1):28-40.

doi: 10.1016/j.ribaf.2015.09.002

6. Yavrumyan E. Efficient Market Hypothesis and Calendar Effects: Evidence from the Oslo Stock Exchange. *University of Oslo*. 2015.

pdf: <https://core.ac.uk/download/pdf/30905279.pdf>

7. Capstaff J. Share Price Reaction to Dividend Announcements: Empirical Evidence on the Signaling Model from the Oslo Stock Exchange. *Social Science Electronic Publishing*. 2017; 8(1/2):115-139.

doi: 10.17578/8-1/2-4

8. Nielsson U. Essays on stock exchange merger, competition and integration. *Columbia University*. 2009.

pdf: <https://www.proquest.com/docview/304873562>

9. Enderlein P H. The Economic Impact of the Deutsche-Brse-NYSE Euronext Merger on the European Financial Markets. *Hertie School of Governance*. 2015.

pdf: <https://core.ac.uk/download/pdf/34001897.pdf>

10. Espinosa-Méndez C, Gorioitía J, Vieito J. Stock exchange mergers: a dynamic correlation analysis on Euronext. *Portuguese Economic Journal*. 2019; 19:81-98.

doi:10.1007/s10258-019-00160-5

11. Choi, Jin W. An Examination into Rationality and Operational Efficiency of Exchange Mergers. *Journal of Economic Asymmetries*. 2009; 6(1):89-103.

doi: 10.1016/j.jeca.2009.01.007

12. Charles A, Darne O, Kim J H, et al. Stock Exchange Mergers and Market Efficiency. *Applied Economics*. 2016; 48(7-9):576-589.

doi: 10.1080/00036846.2015.1083090

13. Fama E F. The Behavior of Stock-Market Prices. *The Journal of Business*. 1965; 38:34-105.

doi: <https://doi.org/10.1086/294743>

14. Hovdahl C. Efficiency at the Oslo Stock Exchange. *Copenhagen Business School*. 2012.

pdf: https://research-api.cbs.dk/ws/portalfiles/portal/58452320/christian_hovdahl.pdf

15. Beghin J C, Lovell C. Trade and Efficiency Effects of Domestic Content Protection: The Australian Tobacco and Cigarette Industries. *The Review of Economics and Statistics*. 1993; 75.

doi: 10.18001/TRS.5.2.7

16. O'Leary, Christopher. Deutsche lands big tobacco deal as its ABS ambitions soar. *Investment Dealers Diges*. 2000.

doi: 10.18001/TRS.5.2.6

17. Levy D T, Chaloupka F, Lindblom E N, et al. The US Cigarette Industry: An Economic and Marketing Perspective. *Tobacco Regulatory Science*. 2019; 5(2):156-168.

doi: 10.18001/TRS.5.2.7

18. Davis K C, Wylie S, Farley S M, et al. Cigarette Trafficking and Tax Parity: Results of a Natural Tax Experiment. *Tobacco Regulatory Science*. 2019; 5(2):143-155.

doi: 10.18001/TRS.5.2.6

19. Little M, Ross H, Bakhturidze G, et al. Analysis of the illicit tobacco market in Georgia in response to fiscal and non-fiscal tobacco control measures. *Tobacco Control*. 2021.

doi: 10.1136/tobaccocontrol-2020-056404

20. Lo A W, Craig M. Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test. *Review of Financial Studies*. 1988; (1):41-66.

doi: 10.1093/rfs/1.1.41

21. Kwiatkowski D, Phillips P, Schmidt P. Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of Econometrics*. 1992; 54(1-3):159-178.

doi: 10.1016/0304-4076(92)90104-Y

22. Chow K V, Denning K C. A simple multiple variance ratio test. *Journal of econometrics*. 1993; 58(3):385-401.

doi: 10.1016/0304-4076(93)90051-6