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Arbitrage with Exchange-traded Funds: A Case of E1VFVN30 Based on Intraday Data

Huyen Phuong Do
Vietnam National University, Hanoi - International School, Hanoi, Vietnam
E-mail: dphuyen@vnu.edu.vn

Bich Ngoc Do
International Business - Marketing School - University of Economics Hochiminh City, Hochiminh City, Vietnam
E-mail: bichdn@ueh.edu.vn

Tra My Nguyen
School of Business and Management, RMIT University, Hanoi City, Vietnam
E-mail: s3725957@rmit.edu.vn

Thinh Vu Duy
Independent Researcher, Hanoi, Vietnam
E-mail: thinh.vu1812@gmail.com

Abstract
This paper explores the arbitrage opportunity of exchange-traded fund (ETF) specifically on Vietnamese *stock market. The intraday data of the first local ETF, VNMVN30 on HOSE – Hochiminh stock market has been tracked and analyzed for one month. The findings reveal that the VNMVN30 ETF has a small deviation in price. This deviation* is *persistent with low change level between* one-*minute* intervals. This outcome contributes *to current literature of arbitrage opportunities in emerging markets. Furthermore,* as a *practical contribution, the investors in ETF investment will* significantly benefit *as this paper suggests* a *pattern of VNMVN30 ETF in a day and estimates transaction costs related* to *arbitrage strategies of E1 VFN30.*

Keywords: Intraday, Arbitrage opportunity, Exchange-traded fund (ETF), E1VFVN30, Vietnam

JEL classification: E44, G12, G14

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1. Introduction

ETFs have become one of the most remarkable financial tools for investors. In 2020, the total assets of ETFs reached approximately 7.8 trillion dollars (Statista, 2020). Research studies on international scales have increasingly drawn focus to ETF effectiveness and efficiency. The reason for choosing E1VFVN30 includes it being the first local Vietnam-based ETF (since 2014)

and the most successful ETF in Vietnam with an increase in value of around 34 times compared to the date of inception (from 9 million USD in 2014 to 301 million USD in 2020) while one other local ETF just was born in 2017 and the remaining 5 local ETFs were born in 2020.

In order to understand closely the advantages that ETF brings to markets and investors, multiple studies have been conducted to examine its efficiency and researchers have portrayed various ways to evaluate the ETFs' effectiveness and efficiency. Existing literature has been divided into three themes. First group studies pricing efficiency, second one looks at tracking ability, and the third one investigates the effects on underlying securities. Firstly, pricing efficiency is a contemporary topic that attracts great interest of many researchers and economists. Ackert and Tian (2000) and Edwin et al. (2002) found out that there is no significant premium or discount. Engle and Sarkar (2006) illustrated that price deviations are relatively small, and these differences are within the transaction cost and bid-ask spread (Charupat and Miu, 2013). Research also shows that the price of ETF is efficient and arbitrage pricing mechanism of ETFs works efficiently (Hilliard, 2014; Hsinan et al., 2006). Secondly, tracking error (TE) is answering the question: how did ETFs mirror their indices by comparing NAV returns of funds and return on corresponding underlying indices. These deviations are often accumulated over time, so they become more and more significant and affect long-term performance of ETFs (Charupat and Miu, 2013).

Researchers also compare performance of different ETF funds tracking the same underlying index. Tracking error is now considered one of the most crucial criteria for investors in selecting an ETF fund when there are the same ETFs fund tracking the same underlying asset. Based on the ETF global survey of Ernst and Young (2014), around 50% of interviewed investors consider TE in choosing ETF funds, the figures for management fees and size of fund are 5% and approximately 10%, respectively (Young, 2014). TE is a measure for quality especially for passive index tracking. Thirdly, researchers focus on effects of introduction of ETF on the underlying assets. After the introduction of an ETF, liquidity of underlying assets may change. Various studies investigate how the introduction of ETFs affects liquidity of underlying assets on mature capital markets, namely, the U.S and European markets. This issue is controversial and the empirical evidences are mixed between the investor recognition hypothesis, the adverse selection hypothesis, and the arbitrage hypothesis. While the adverse selection hypothesis predicts a decrease in liquidity of underlying assets after the introduction of ETFs, the investor recognition and the arbitrage hypotheses forecast an increase in liquidity of underlying stocks (Winnie et al., 2014, Richie and Madura, 2007, Hedge and McDermott, 2004, Fremault, 1991, Merton, 1987).

Other recent studies have shifted their attention to emerging markets such as China (Jin et al., 2020) and their trade opportunities thanks to globalization and economic integration. In Vietnam, ETFs have been on the market since 2008; however, there has been little attention on ETF's stock market investigation. Hence, this research emphasizes on a case of first local-based ETF (VNMVN30) and examines possible arbitrage opportunities for investors. Compared to the ASEAN region, in 2020, Vietnam's ETF ranked second in terms of total net asset value and second in terms of size, just after Singaporean ETFs with 1.33 billion USD (ETFGI, 2020). This paper is one of the pioneering researches on ETF arbitrage on Vietnamese market, hence making it an important research gap and a vital contribution to literature.

The results are expected to bring a better perspective for investors in investment decision-making when trading Vietnam-based ETF. This paper is divided into 4 sections, namely: (1) Literature

review on ETF; (2) Data and research methodology for the case of E1VFVN30; (3) Discussion of research results and (4) Conclusion and recommendation for investors trading E1VFVN30.

2. Literature review

2.1. Exchange-traded-fund characteristics

Exchange-traded-fund (ETF) is a combination of a traditional open-end mutual fund, where "investors can create/redeem their share in the fund at net asset value", and a close-end fund, where "capitalization is fixed" (Cui et al., 2019, p.196). ETF was created to combine and utilize the characteristics of the two. It is similar to close-end funds in that the shares can be traded on the stock exchange, and similar to open-end fund in that the funds can grow or shrink depending on the demand of end-investors. (Novick, et al., 2017). Ferri (2009) defined that "Exchange-traded funds (ETFs) are baskets of securities that are traded, like individual stocks, through a brokerage firm on a stock exchange" (p.xvii). Therefore, ETFs have number of shares at the end of a trading day changing based on creation and redemption process and allow more types of investors to join in that market compared to the other two previously mentioned funds. In particular, on ETF primary markets, ETF participants would include ETF sponsors; Authorized Participants (APs); Market makers, whereas on secondary markets, ETF participants would be Stock exchange; Financial Advisers and Brokers; Investors; Share registrar (Novick et al., 2017).

From a small, niche index-tracking product and over 20 years of growth, ETFs have successfully become a popular innovation in terms of investment tools on financial markets. Until the end of September 2018, there were total 7,553 ETFs/ETPs (exchange-traded products) listed on 69 exchanges in 57 countries with 14,643 listings, assets of $5.25 trillion in the global ETF/ETP industry (ETFGI, 2018). Because of its development, it has become necessary to closely understand the advantages as well as disadvantages that ETF brings to markets and investors resulting in numerous studies in the research area. Examples include an examination of SPDR pricing, which is an ETF that tracks S&P 500 index, and a finding of no significant premium or discount (Ackert and Tian, 2000 and Edwin et al., 2002). The latter also illustrated that because arbitrageurs can take advantage of the difference between ETF's market price and its NAV, the arbitrage opportunity would disappear within one day (Charupat and Miu, 2013). Hilliard (2014) investigated the price difference of ETFs traded in the United States from April 20, 2010, to April 20, 2011 using the premium/discount of ETF market price to its NAV (defined as below) formula and found out that the arbitrage pricing mechanism of ETFs is highly efficient. In that research, he showed that the overall average deviation of all ETFs' market prices is relatively small compared to their NAV (at about 0.05%), which is 80 times smaller compared to other discounts documented for closed-end funds:

$$p_t = \frac{P_t - NAV_t}{NAV_t} \times 100\% \quad (1)$$

where: P_t is the price of one share of the ETF and NAV_t is the net asset value per share. Besides, they also use the mean-reverting process with jumps to improve the model fit (Hilliard, 2014). Moreover, Hsinan et al. (2006) based their research on two measurements: (1) the deviation of price from NAV and (2) the absolute value of mispricing. They suggested that the price of Taiwan Top 50 Tracker Fund (TTT) is efficient when the TTT tends to sell at a premium (at just

0.041%, which is not significant) and the absolute mispricing value is a statistically significant deviation percentage (at 0.383%), providing a minimal arbitrage opportunity (Hsinan et al., 2006).

In Vietnam, ETFs have appeared on the market for approximately 10 years (since 2008) and in fact, there have been a few academic articles that investigated ETFs' case on the Vietnamese stock market. By using three different liquidity proxies (Absolute Spread, Relative Spread and Amihud Ratio) and the Investor Recognition theory to explain, Nguyen and Do (2017) showed that the liquidity of stocks that comprised the ETF decreased after the first Vietnamese-based ETF (DBX) was introduced in 2008; however, its liquidity enhanced significantly after other two ETFs were introduced in 2009 and 2014 (VNM and E1VFVN30, respectively) (Nguyen and Do, 2017). Furthermore, Vinh and Kiem (2016) carried out research on the reaction of Vietnamese stock market to the announcement of changes in the VanEck Vectors Vietnam ETF (VNM) in 2016 and found out that although abnormal return does not exist on the announcement day, it appears before and after that date (Vinh and Kiem, 2016).

Recently, Do (2019) investigated pricing efficiency of three ETFs tracking Vietnamese stock market including E1VFVN30 and two foreign ETFs (DBX and VNM: most underlying stocks from Vietnam and trading on foreign exchanges) from 2014 to 2016. The research calculated premiums/discounts which are typically measured by the following formula in terms of dollar prices between the price of ETFs and the NAV of the correspondent funds (Do, 2019). A positive discount means that the fund trades at a premium.

$$discount = \frac{(ETF_t - NAV_t)}{NAV_t} \times \frac{(ETF_t - NAV_t)}{NAV_t} \times 100\% \quad (2)$$

After estimating percentage discount by the above formula, we turn the attention to the persistence in premium/discount by using Rompotis' (2011) model by single-factor model regression.

$$discount_t = \alpha + \beta discount_{t-1} discount_{t-1} + u_t u_t \quad (3)$$

The result shows that the discounts of VNM and E1VFVN30 are strongly significant, different from zero at 1% level of significance. Moreover, the beta estimates of VNM and E1VFVN30 are positive and strongly significant at 1% that indicates strong discount persistence. In other words, there are significant arbitrage opportunities based on the trading price and NAV of ETF shares – the arbitrage opportunities persist for longer than the trading day. The research also estimates that the total arbitrage cost of E1VFVN30 ranges from 1.1 to 1.25%. However, one of the limitations of the study is using daily data to identify arbitrage opportunities. The key characteristic of an arbitrage is simultaneity in buying and selling of one asset on different markets or different forms in order to exploit and benefit from the short-lived price differences; arbitrage appears in a short time and disappears quickly by astute traders (Lazzarino et al., 2018). NAV is measured at the end of the day – both prices and NAV may be measured with errors (Engle and Sarkar 2006). "In the closed-end pricing literature, early attempts to explain the behavior of fund discounts and premiums focused on mismeasurement of reported NAVs" (p.28). Similarly, liquidity is measured based on daily data, especially, Absolute spread and Relative spread are used as liquidity proxies that may lead to inexact estimations due to data limitations.

Based on current literature on Vietnamese ETF market, using intraday data to test pricing efficiency and identifying ETF arbitrage opportunities can be considered a research gap.

2.2. Arbitrage mechanism in ETF

ETF creation starts when ETF sponsors create a new fund or ETF shares and trade with Authorized Participants (APs) for the appropriate basket of stocks that comprise the new ETF. In exchange, the sponsor gives the APs a block of equally valued ETF shares, called a "creation unit" (in Vietnam, a creation unit of ETF equals to 100.000 shares of ETF) (Vietfund Management, 2014). At the end of the process, the ETF sponsor gets the stocks and cash needed to track the index; the APs get the creation unit of the ETF and provide those shares on the secondary market (Ferri, 2009). On the other side, the redemption process works in reverse: APs can remove ETF shares from the market by purchasing enough of those shares to form a creation unit and then deliver those shares to the ETF sponsor to receive the same value in the underlying securities of the fund in exchange. (Novick et al., 2017)

Typically, all the creation and redemption orders are in the form of in-kind transactions and only APs are permitted to place orders and redeem directly from ETF sponsors. As for the secondary market, ETF shares are traded like other shares on the stock exchange: individual investors, small organization or retail investors will transact shares with others on a trading venue or exchange (Ferri, 2009; Novick et al., 2017). Theoretically, APs or arbitrageurs can earn money from doing arbitrage trade: when market price of ETF shares are lower (higher) than its NAV, arbitrageur can do arbitrage trades, and as a result, it narrows the discrepancy between their market price and NAV until typically, there is no arbitrage opportunity in the market (Hilliard, 2014). However, in reality, ETF arbitrage is not riskless, and investors/ APs can drop out of the ETF arbitrage because of numerous reasons. Thus, even though there are price deviations between market price of ETFs and its NAV, the arbitrage may not occur when investors or APs perceive that it is not worthy to invest (Pan and Zeng, 2017).

2.3. Hypotheses development

According to previous research, average price deviations of domestic ETFs are relatively small. For example, Hilliard (2014) reported that domestic equity ETFs were traded at a discount of 0.03, and the result is similar to the finding of Engle and Sarkar (2006); Ackert and Tian (2008); and Hsinan et al. (2006). They illustrated that domestic ETFs are traded at premium of 0.01%, 0.02% and 0.041% respectively (Hilliard, 2014; Ackert and Tian, 2008; Charupat and Miu, 2013; Hsinan et al., 2006). Moreover, in the research of Ackert and Tian (2000) and research of Edwin et al. (2002), they also depict that the existence of domestic ETFs' premium (discount) is within one day (Ackert and Tian, 2000; Edwin et al., 2002). Besides, following research of Engle and Sarkar (2006), its differences are within the transaction cost and bid-ask spread (Charupat and Miu, 2013). Do (2019) employed daily data and found that discounts of E1VFVN30 are strongly significant, different from zero at 1% level of significance. Moreover, strong discount persistence is indicated through statistical significance of E1VFVN30 beta estimates (1%). In other words, there are significant arbitrage opportunities based on the trading price and NAV of ETF shares – the arbitrage opportunities persist for more than just one trading day. Therefore, regarding the Vietnam-based ETF with intraday data, E1VFVN30 may be priced efficiently and the following hypotheses are formulated:

H_1: The value of premium of E1VFVN30 is equal to 0
H_2: The premium between two minutes of E1VFVN30 is non-persistent

Furthermore, this paper also measures the transaction costs of ETF arbitrage activity to find out signals for investors who tend to invest.

3. Methodology

3.1. Data observation

This study focuses on ETFs shares observation of VFMVN30 fund (fund code: E1VFVN30). Data of intraday net asset value (iNAV) at one-minute intervals and the trade activities of 31 shares that listed on HOSE being the main stock market trading in Hochiminh city. The data set includes ETF shares of E1VFVN30 and 30 shares in VN30 Index on 19 trading days of September 2018, (from September 4, 2018 to September 28, 2018). The information is collected from Vietfund management company, Viet Dragon Securities Corporation website, cophieu68.com, and BaoViet Securities Company.

As for the iNAV, the exact data which is presented at 15-second intervals on the live stock quote of HOSE cannot be collected because of regulatory restrictions. However, it can be estimated by using the intraday value of VN30 Index with a shortcut formula, which is:

$$iNAV_t = \frac{R_t}{R} \times NAV \tag{4}$$

where: $iNAV_t$ is the value of iNAV at the time of observing; R_t is the return of VN30 Index at the time of observing; R is the return of VN30 Index at the end of previous day; NAV is the net asset value at the end of the previous day.
Because the difference between real and estimated value is relatively small (p-value is at about 0.988), the estimated value of iNAV can be accepted to use in the research. The total data of iNAV value and daily trading activities of 31 shares that are listed on HOSE is about 4903 observations and 137 838 observations, respectively. However, after filtering data, the dataset that this paper employs consists of 130 026 observations.

3.2. Research method

This research is conducted using a three-step approach.

Step 1: The Pricing efficiency measurement of E1VFVN30
The pricing efficiency of E1VFVN30 and arbitrage opportunity in E1VFVN30 trade activities, the premium/discount of that ETF is calculated by using the formula that Hilliard (2014) used in his research, which is:

$$p_t = \frac{P_t - NAV_t}{NAV_t} \times 100\% \tag{5}$$

where: P_t is the price of one share of the ETF and NAV_t is the net asset value per share (Hilliard, 2014). If a premium is negative, it means the fund is traded at a discount. In other words, the market price of E1VFVN30 is lower than its iNAV, which may lead to a redemption process and vice versa.
This paper also uses t-test for the data of E1VFVN30's premium (discount) to test the efficiency of the trading price of E1VFVN30.

Step 2: The persistency of E1VFVN30's premium measurement
A regression model is conducted to test the persistency of premium within one minute intervals. The regression model is built with dependent variable being current premium (discount), previous premium (discount) being lagged explanatory variable:

$$Premium_t = \alpha + \beta \times Premium_{t-1} \quad (6)$$

The regression model is adopted from Rompotis (2011) by single –factor model regression. Positive and significant beta estimates will imply that premiums/discounts persist throughout two successive days. On the other hand, negative or insignificant betas indicate that there is no persistence in premium/discount. In the other words, negative or insignificant beta shows that there are no arbitrage opportunities between trading on ETF markets and underlying markets. In this research, intraday data is employed. If beta is significantly positive, the premium of E1VFVN30 between two minutes is persistent and vice versa, if beta is insignificant, or negative different than 1, there is no evidence to conclude that the premium of E1VFVN30 is persistent

To ensure the consistency of the regression model, Dickey-fuller test is applied in this thesis to test the stationary of the time series of premium. The null hypothesis is that a unit root is presented in an autoregressive model and the alternative hypothesis is that there is no unit root and the model is stationary.

Step 3: Transaction costs estimation
Following research of Hsinan et al. Hsu (2006), arbitrage behavior is related to the magnitude of price deviation rather than whether it is traded at premium or discount because if the value of absolute premium (discount) is large enough to cover the costs, arbitrage will happen (Hsinan et al., 2006). The absolute premium (discount) value is defined as:

$$|p_t| = \frac{|P_t - NAV_t|}{NAV_t} \times 100\% \quad (7)$$

Moreover, besides the research of Hsinan et al. (2006), this study also considers liquidity risk as a cost to the investors when participating in trading ETF. The percent of quoted spread and percent effective spread is computed in this paper as transaction cost measures of liquidity (Nguyen and Do, 2017). The detail of two measures' formulas is shown in the table below:

Table 1 – Formula details

Liquidity measure	Computation	Studies using the measure
Percent quoted spread	(Ask price – bid price)/mid price	Bourghelle and Declerck (2004), Lecce et al. (2012), Cumming et al. (2011), Beber and Pagano (2013), Marshall et al. (2013)
Percent effective Spread	2 x |ln(trade price)- ln(quote midpoint)	Bourghelle and Declerck (2004), Brockman et al. (2009), Lecce et al. (2012), Marshall et al. (2013), Kang and Zhang (2014)

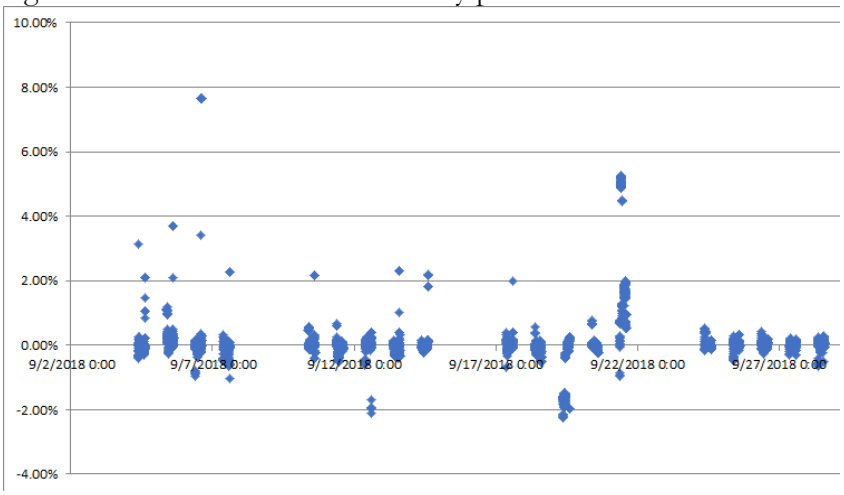
Therefore, the formula to calculate the transaction cost will be: Transaction cost = Commission fee + Creation/ Redemption fee + Tax + Liquidity cost.

4. Empirical data analysis

4.1. The pricing efficiency measurement

The dot chart as shown below (Figure 1) depicts the percentage of E1VFVN30's intraday price difference between market price and its iNAV in September 2018. The intraday price deviations of this fund are close to 0 and most of the day in September, E1VFVN30 is traded at premium (iNAV is lower than market price). In particular, about 17 out of 19 days of the month, the price deviations scattered closely around the horizontal axis during the period from 9:15 AM to 2:00 PM. Therefore, the most active time on the stock exchange market of E1VFVN30 is during the day (which is after 9:15 AM until 2:00 PM) and during this period trade price is close to its NAV or price of this fund is efficient. Moreover, the highest and lowest peaks are often identified at the beginning or at the end of continuous order-matching of Ho Chi Minh stock exchange (HOSE) (which is around 9:15AM and 2:30 PM respectively).

Figure 1 – The E1VFVN30's intraday premium



Source: Author's calculations.

Table 2 illustrates results of data analysis of premium (discount) of this Vietnamese-based fund in September 2018 (as shown below).

Table 2 – Descriptive statistics of E1VFVN30

Mean	0.10%
Standard Error	0.01%
Median	0.01%
Mode	0.52%
Standard Deviation	0.76%
Minimum	-2.26%
Maximum	7.63%
Count	4875
Confidence Level (95.0%)	0.02%

Source: Author's calculations.

As presented in Table 2, generally, E1VFVN30 is traded at a low-rate premium (0.1%) and the standard error is small (which is +/- 0.01%). The maximum value is over 7% (at 7.63% in specific) and the minimum is lower than -2% (at -2.26%) while in the total dataset of 4875, the median price deviation is at a premium of 0.52%. This result is similar to the research of Hsinan et al. (2006) when the share of this fund is on average traded at premium to its NAV (Hsinan et al., 2006). Furthermore, the t-test method is also applied in this study to examine the hypothesis that the percentage of price deviation equals to zero and the result is shown as per table 3 below:

Table 3 – One sample t-test with null hypothesis: mean intraday premium = 0

Variable	Obs	Mean	Std. Err	Std. Dev	[95% Confi.	Interval]
Premium	4875	0.0009589	0.0001091	0.0076205	0.0007449	0.0011728
Mean = mean (Premium)						
Ho: mean =0						
					t= 8.7853	
					Degrees of freedom = 4874	
Ha: mean<0		Ha: mean =0			Ha: mean>0	
Pr (T<t) = 1.0000		Pr (|T|>|t|) = 0.0000			Pr (T>t) = 0.0000	

Source: Authors' analysis.

From the above analysis, p-value is relatively small and close to 0 (less than 0.05), the intraday premium mean of E1VFVN30 is significantly different compared to hypothesis H0: mean = 0%. Thus, if E1VFN30 also has the absolute premium mean exceeding its transaction cost, arbitrage opportunities exist.

4.2. The persistency of E1VFVN30's premium

This study performs the Dickey-Fuller test and finds out that p-value of this test is close to 0, thus, the null hypothesis is rejected, and the series is stationary. Moreover, table 4 as shown below depicts the results of simple linear regression defining the current premium at t as the dependent variable ($Premium_t$)$Premium_t$) and its previous premium at t-1 as independent variable ($Premium_{t-1}$)$Premium_{t-1}$). Specifically, the coefficient is 0.956 which is close to 1, therefore, the

change between the price deviations at one-minute intervals is insignificant or almost identical. The square root of R^2 (= $\sqrt{0.9135} = 0.9558\sqrt{0.9135} = 0.9558$) depicts the relationship between current and previous premium. Thus, it can be said that there is a close relationship between the price deviations in one-minute intervals. In other words, the intraday premium between minutes is persistent and the change is insignificant.

Table 4 – Regression relationship between price deviations at one-minute interval

.reg Premium LagPremium

Source	SS	df	MS	Number of obs	=	4,874
				F (1, 4872)	=	51461.89
Model	.258562373	1	.258563473	Prob > F	=	0.0000
Residual	.024478721	4,872	5.0244e-06	R-squared	=	0.9135
				Adj R-squared	=	0.9135
Total	.283042194	4,873	.000058084	Root MSE	=	.00224

Premium	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LagPremium	.955783	.0042132	226.85	0.000	.9475232	.9640429
_cons	.0000419	.0000324	1.30	0.195	-.0000215	.0001054

Source: Calculated by Stata 14.2.

4.3. Transaction costs for arbitrage strategies

Preceding transaction cost calculation, this study employs the absolute premium as revenue of investors when doing arbitrage of E1VFVN30. By using the price data of E1VFVN30, the results show that the average value of the absolute premium is about 0.29% with the maximum value being approximately 7.63%. Data analysis can be seen in Table 4 below:

Table 5 – Descriptive Statistics of absolute price deviation E1VFVN30

Mean	0.29%
Standard Error	0.01%
Median	0.08%
Mode	0.52%
Standard Deviation	0.71%
Minimum	0.00%
Maximum	7.63%
Count	4875
Confidence Level (95.0%)	0.02%

Source: Author's calculation.

Assumption is that the value of trading stocks is 1 billion Vietnam Dong (VND) and all transactions will be performed at the trading floor. After doing research and calculating the fees, all the costs of E1VFVN30 in relation to each step of trading this fund is listed in Table 6 below to give an overview of costs that might be borne by investors.

Table 6 - Transaction cost of trading E1VFVN30

Process		Name of cost	Objects	Cost (%)
Step 1: Creation When price of E1VFVN30 > iNAV	Buy underlying stocks	Commission fee	Investors	0.20%
		Liquidity cost	APs/ Investors	0.27%
	In-kind creation	Creation fee	APs/ Investors	0%
	Selling point	Commission fee	Investors	0.20%
		Liquidity cost	APs/ Investors	0.35%
		Tax	APs/ Investors	0.1%
Redemption When price of E1VFVN30 < iNAV	Sell underlying stock	Commission fee	Investors	0.20%
		Liquidity cost	APs/ Investors	0.27%
		Tax	APs/ Investors	0.1%
	In-kind redemption	Redemption fee	APs (also Market maker)	0%
			Aps	0.1%
			Investors	0.15%
	Buying E1VFVN30	Commission fee	Investors	0.20%
		Liquidity cost	APs/ Investors	0.35%

The variances are explained as following:
- Commission fee: Average commission fee of 5 leading securities firms in quarter 03/2018 according to HOSE in Vietnam will be computed (Ho Chi Minh stock exchange, 2018)
- Tax: Based on regulation, tax rate will be at 0.1% of trading price for each transfer (Ministry of Finance, 2013; National Assembly, 2014; Vietnamese Government, 2015)
- Liquidity cost: Average of two measures listed in table 6 (as mentioned above) will be considered liquidity cost relating to stock transaction costs
- Creation/ Redemption fee: Following the regulations of E1VFVN30 in its prospectus 2014, the fee of creation for all types of participants involved in trading the shares of this fund is at 0% per unit. However, as for redemption fee, it depends on each types of investors, the fee will vary (from 0% to 0.15%) (Vietfund Management, 2014)
As mentioned in prior section, the formula to calculate the general transaction cost will be:

Transaction cost = Commission fee + Creation/ Redemption fee + Tax + Liquidity cost (for underlying securities and E1VFVN30)

Creation mechanism:
When the market price of an ETF is higher than its iNAV, a creation process occurs as discussed above, therefore, the transaction cost related to creation mechanism for each type of investors listed below and the maximum total cost of selling E1VFVN30 is 1.12 %.

Table 7 – Maximum transaction costs in creation process

Types of investors	Transaction cost
Authorized Participants	0.72 %
Investors	1.12 %

Source: Author's calculation.

Redemption mechanism:
In contrast, when the market price of an ETF is lower than its iNAV, a redemption process will happen as mentioned above, thus, the transaction cost in relation to redemption mechanism for each type of investors listed below and the maximum total cost of buying E1VFVN30 is 1.27 %.

Table 8 – Maximum transaction cost in redemption process

Types of investors	Transaction cost
Authorized Participants (also Market maker)	0.72 %
Authorized Participants	0.82 %
Investors	1.27 %

Source: Author's calculation.

Bringing these results into comparison with the absolute price deviation of E1VFVN30 (at average 0.29%), yields a difference which is economically insignificant. Taking into account arbitrage costs, it can be hard to attract investors and arbitrageurs to invest. This result is similar to the result of Hsinan et al. (2006). Reverting back to hypothesis 1, the study reveals that ETF premium is significantly different from zero, it shows that E1VFVN30 is priced inefficiently, however, after considering actual transaction cost involved in arbitrage opportunities, we can conclude that E1VFVN30 is priced efficiently.

5. Conclusion and recommendation

The main objective of this study is to investigate the pricing efficiency of E1VFVN30. By using intraday data of the fund in September 2018 and employing the premium/discount formula as a measure, empirical evidence suggests that the E1VFVN30 tends to sell at low premium rate (on average, 0.1% +/- 0.01%), however, that intraday premium is significant. Furthermore, as for absolute price difference value, compared to the maximum total transaction costs of buying E1VFNV30 (at 1.35%) and selling E1VFVN30 (at 1.1%) that investors would have to pay when trading the shares of this fund, the absolute value is relatively small (on average 0.29%), thus, it could provide a minimal arbitrage opportunity for investors. In short, E1VFVN30 is priced efficiently.

On the other side, the intraday price differences are persistent and the change in it is insignificant at one-minute intervals. Through the intraday premium percentage of E1VFVN30 in September 2018, it depicts that the price of E1VFVN30 is efficient after 9:15 AM until 2:00 PM - the most active time of E1VFVN30's market and inefficient at the beginning or the end of continuous order-matching of HOSE (at around 9:15AM and 2:30PM). Those findings may help investors choose the time of trading the shares E1VFNV30 more effectively and efficiently.

This paper also estimated the transaction costs relating to E1VFVN30's arbitrage strategies. In this paper, it is assumed that the value of trading stocks is 1 billion Vietnam Dong (VND), all transactions are performed at the trading floor and consider only certain types of investors. The result is that the maximum total cost of selling and buying E1VFVN30 are 1.12 % and 1.27 % respectively. The result of this could be a signal for investors when they intend to do arbitrage of ETF shares to gain profit.

Despite valuable findings, this study still has a number of limitations. First of all, because of regulatory restrictions, this paper cannot collect the exact data of intraday net asset value which is presented at 15-second intervals on the live stock quote of HOSE. Instead, it is calculated based on assumption and formula that is given by an expert in managing an ETF, thus, there still exists deviation in the data. However, the difference is relatively small (p-value is at approximately 0.988), therefore, those estimated values of iNAV can be accepted to use in the research.
Secondly, due to limited scale, information and data of other ETFs (both Vietnam-based and foreign) in Vietnam exchange stock were not collected, hence unable to generalize results for ETFs in the Vietnam context. The study only focuses on E1VFVN30 and the transaction costs relating to each type of investors. Also, there are a few case studies on ETFs in Vietnam and most of recent research about pricing efficiency of ETFs in Vietnam use data of NAV instead of iNAV to conduct. Hence, future research may examine the pricing efficiency and other external factors that affect transaction costs by using iNAV and compare the results with those findings of this research to gain an overview of ETFs in the Vietnamese market.

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