The role of Exchange Traded Funds in the price discovery process of stocks listed on the Botswana Stock Exchange

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Abstract

In this paper we analyse the role of Exchange Traded Funds (ETFs) in the price discovery process of stocks listed at the Botswana Stock Exchange. Using daily returns data covering the period 3 January 2013 to 31 December 2015 for Beta Betta ETF and Domestic Company Indices, we utilize a VECM model to find out whether the Betta Beta ETF is playing a significant role in the price discovery process of stocks listed on the Botswana Stock Exchange. We found the error correction term to be statistically significant thereby confirming that the Betta Betta ETF is playing a significant role in the price discovery of stocks listed on the Botswana Stock Exchange.

Key Words: Price discovery, Exchange Traded Funds, stock exchange.

JEL classification: G21; G28; G35

Introduction

The role of financial markets in the price discovery of stocks cannot be underestimated. The efficiency with which prices are discovered very much depends on the procedures, rules, and regulations that govern how orders are submitted, brought together, and turned into trades (Alan and Schwartz, 2013). The ideal is to have efficient markets in which 'asset prices will completely and instantaneously reflect movements in underlying fundamentals (Andersen et al., 2006). Considering that investors generally disagree about the price of an asset, determining the equilibrium price that approximately reflects the fundamental value of an asset is the most important function of a financial market. Efficient price discovery requires financial markets that can 'efficiently incorporate various sources of information into an equilibrium price' (Chen and Gau, 2007). Therefore any mechanisms or arrangements available in the financial markets that aid the efficient delivery of information related to stocks is likely to attract attention in financial literature.

A notable trend influencing price discovery in financial markets has been the trading of identical or closely related assets in multiple market places (Yan and Zivot, 2007). In recent times, of particular interest has been the trading of Exchange Traded Funds (ETFs) alongside underlying securities in stock markets. An ETF is a financial instrument which is composed of a basket of securities that replicate the performance of
the underlying securities to provide an investor the same benefit as holding a diversified portfolio of individual assets. Due to their ability to offer a diversified portfolio to investors, ETFs are becoming increasingly popular among investors and as a result are now being traded in most stock markets around the world. The ability of an ETF to replicate the performance of the underlying securities means that they can potentially influence their price discovery process. Thus, the increasing popularity of ETF trading in stock markets across the world is a positive development in as far as the price discovery of stocks is concerned.

At the Botswana Stock Exchange, the first ETF was introduced on the 11th of May 2011. Known as Beta Betta, the equity based ETF is primarily listed on the Johannesburg Stock Exchange and is composed of 40 equities. The Botswana Stock Exchange is a relatively illiquid market and as such the Beta Betta ETF was primarily introduced to improve liquidity of the market. Since ETFs aid the price discovery process of stocks, the introduction of Beta Betta ETF at the Botswana Stock Exchange may also have provided a mechanism that aid the price discovery of stocks listed on the BSE.

Infact the contribution of Beta Betta ETF to the price discovery of stocks listed on the BSE may have improved significantly over the years. This is because the liquidity levels of the Beta Betta ETF market have significantly increased since its introduction in 2011. Statistics from the Botswana Stock Exchange show that trading volumes of the Beta Betta ETF increased from 1 143 370 units in 2011 to 10 439 416 units in 2015, representing a percentage increase of about 800% (see Table 1 below). This means that trading of the ETF may have become more liquid and efficient relative to that of the illiquid underlying stocks (Bernstein, 2015). Thus, it may be reasonable to speculate that the the Beta Betta ETF is significantly influencing the price discovery of stocks listed at the BSE.

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnover(P)</td>
<td>37,229,615</td>
<td>38,876,378</td>
<td>774,890</td>
<td>170,253,020</td>
<td>427,688,318.40</td>
</tr>
<tr>
<td>Units traded</td>
<td>1,143,370</td>
<td>1,121,502</td>
<td>20,519</td>
<td>4,023,278</td>
<td>10,439,416</td>
</tr>
<tr>
<td>Unit price</td>
<td>31.10</td>
<td>39.35</td>
<td>37.15</td>
<td>38.55</td>
<td>37.70</td>
</tr>
</tbody>
</table>


Though trading volume of the Beta Betta ETF have increased significantly over the years, we are unsure if the liquidity levels have risen high enough to contribute significantly to the efficient price discovery on the BSE. In this study we apply the VECM model investigate the role that the Beta Betta ETF is playing in the price discovery of stocks listed on the BSE. We make use of daily returns data for the period 2013 to 2015 to investigate the role of the Beta Betta ETF in influencing the price discovery of stocks listed at the BSE. The study is expected to have implications on the development and promotion of ETFs trading at the Botswana Stock Exchange in particular and other stock markets around the world. The rest of the study is laid out as follows: Section 2 presents the Literature Review, Section 3 presents data and methodology, Section 4 presents the results and discussion and section 5 concludes the study.

**Literature Review**

The role of financial markets in the price discovery process of financial assets has been of much interest to researchers in the field of financial economics. Of particular interest in the past years has been the role of derivative markets in the price discovery of underlying stocks. Derivative markets are markets for the trading of derivative instruments such as futures and options, whose value depend on the underlying security. Though a derivative market is distinct from a market for the underlying security, the close relationship that exists between them creates possibilities for information exchange between the securities thereby influencing the price discovery of processes of the underlying assets concerned. Thus, informationally linked markets, such as futures, options and spot markets, have been the focus of attention in numerous studies concerning price discovery (Chen et al, 2015).
Numerous empirical studies have proved the significance of derivative instruments such as futures and options in the price discovery of stocks (for example Theisssen, 2012; Floros, 2009; Garcia et al, 2014). A much recent financial innovation that is generating much interest regarding its role in the prices delivery of stocks are Exchange Traded Funds (ETFs). ETFs, that started to be traded for the first time in North American stock exchanges; have become one of the most popular financial instruments demanded by investors across Europe and other continents (Başa and Sarroğlu, 2015). Their popularity stems largely from the benefits they provide to investors which include the liquidity, ease of trade, and lower cost associated with an exchange traded product, and diversification opportunities (Foucher and Gray, 2014). Their development started in the early 90’s with a single product which consisted of a basket of single securities that where part of the S&P 500 index which later (Solis, 2011). The single product which closely followed S&P 500 index was essentially an equity ETF. Later on, as the popularity of ETFs increased, a number of different ETFs were developed (Solis, 2011). Thus today different types of ETF products which include bond ETF, commodity ETF and derivative ETF are currently being traded in various financial markets around the world.

ETFs are closely related to the underlying assets in almost the same manner as derivatives. Since an ETF is basically a basket of securities traded at the stock exchange as single security, it essentially means that trading in ETFs is actually the same as trading in individual securities, except that one will be trading in a basket of securities. As a result the prices of ETFs tend to closely follow the price of individual securities that are part of the ETF basket of securities. In other words, ETFs aim to replicate the performance of a basket of stocks as closely as possible (Deville, 2008). In a purely efficient market, the price of an ETF is expected to equal the price of its underlying portfolio as the two assets have the same fundamental value (Itzhak, 2012). Although price deviations exist due to market inefficiencies, the ETF value is expected to exactly mimic the value of the underlying asset (Borkovec et al, 2010). This shows that there is a very close relationship between the ETF market and the market for underlying stocks. This close relationship presents possibilities for information exchange between the markets for the securities. Thus, just like derivative instruments, ETFs likely play a significant role in the price discovery of stocks.

It is however important to note that ETFs are not exactly similar to derivatives with regards their relationship with the underlying securities. Whilst ETFs are an exact replica of the underlying securities which are part of the basket, derivative instruments are a completely different financial instrument created to hedge against risks in the underlying security. According to the efficient market hypothesis, when markets are efficient new information should be instantaneously be reflected asset prices (Patel et al, 2016). This means that when two similar markets for the same security are faced with the same information arriving simultaneously, the two markets should react at the same time in a similar fashion, consequently simultaneously adjusting to the new equilibrium at the without any delay (Chung et al, 2007; Lin, 2011). Since ETFs are an exact replica of the underlying security which forms part of the basket; they may receive information at the same time as the underlying security making it impossible for them to influence the price discovery of underlying stocks.

Practically financial markets are far from being perfect. The efficient market hypothesis holds true in the theoretical realm- that is in a perfect market without transaction costs and information asymmetries. In the presence of informational asymmetries and transaction costs, two distinct markets for the closely related securities will not receive the same information at the same time. One market tends to receive information faster than the other market causing a lead-lag relationship between two markets. The market that revives the information faster transmits it to the other market, thereby contributing to the price discovery in that particular market. Even though an ETF is a replica of the underlying security, the existence of imperfect market conditions will ensure that a lead –lag relationship exists between the markets for the ETF and the market for the individual underlying securities. Thus, the imperfect nature of financial markets provides the possibility that ETF may play a significant role in the price discovery of stocks.

Generally, investors incur low transaction costs when trading in ETFs as compared to trading in individual securities. As a result, ETFs are likely to attract higher turnover investors than the average stock in their baskets (Itzhak et al, 2014). In other words, ETF markets tend to attract more participants thereby resulting in an increase in their trading volumes relative to the market for underlying securities. The greater trading
volume increase market liquidity which, in turn, potentially improves information transmission of relevant market information to market prices (Garcia et al. 2014). In other words, larger volumes of trade facilitate price discovery and more efficient prices (Barclay and Hendershott, 2003). Sehgal et al (2013) pointed out that the market that provides the greater liquidity is likely to play a more important role in price discovery. Thus, increased trading volumes and market liquidity of ETFs enables them to play a key role in the price discovery of stocks.

Moreover, ETF market is likely to attract informed traders than the market for underlying securities. The transaction cost hypothesis predicts that the security that incurs the lowest transaction cost will attract informed trading as investors willing to make profits opt to trade in a market with lower transaction costs (Chen and Gau, 2009). Where there are two markets for an asset, new information tends to be reflected first in the market where informed trading takes place (Chakravarty et al, 2004). In that case the price discovery process first takes place in that market with more informed trading. The new information that is reflected in the market with informed trading is then transmitted to the other market, thereby influencing the price discovery process in that market.

Caporale and Girardi (2011) argued that the timely incorporation of information into market prices can be facilitated if agents recognize a certain trading venue as a polar market where informative prices are provided to market participants. With lower transaction costs and high liquidity levels, the ETF market is certainly more likely to be used by investors as a polar market for transmitting information about the prices of underlying stocks. This is because its existence provides an alternative for informed traders to execute long or short strategies in response to new information (Lin, 2011). This means the ETF market has the capability to act as an avenue for which new information is first generated and then transmitted to the underlying stocks. Thus, the ETF market can be used by investors to discover the prices of the underlying stocks.

However, it is important to note that the ability of ETFs to contribute significantly to price discovery depends largely on their relative liquidity. As emphasized by Dehkalani and Ebrahimi (2015) liquidity plays an important role in the process of price discovery. High liquidity levels enable ETFs to capture new information regarding the fundamental value of an asset (Sultan and Zivot, 2015). On the other hand, illiquidity can create information transfer frictions that can impede the ability of ETFs to contribute to the efficient price discovery of stocks (Tucker and Laipply, 2013). This means that without enough liquidity, it will be impossible for an ETF market to contribute significantly to the price discovery of stocks. Thus, the ETF market must be large and liquid enough to offer any significant information that can influence price discovery (Tucker and Laipply, 2013).

A study by Lin (2011) which revealed that the increased trading volume of Taiwan 50 ETF enhanced information transmission and price discovery shows the significance of the extent of liquidity of ETFs in determining the relative rates of information transmission and price discovery in a stock market. Another study by Park et al (2013) revealed that the KODEX200 which has abundant trading volume played a role in price discovery that is more dominant than that of the KOSPI200 index. This further shows the significant impact of the extent of ETF trading volumes in performing price discovery function. Thus, the extent of liquidity of an ETF market should be viewed as critical in analysing its significant role in the price discovery of stocks listed on the BSE.

Data and Methodology

We used daily data for Beta Betta ETF and Domestic Company Indices obtained from the Botswana Stock Exchange. The Domestic Company Index (DCI) was used as a proxy for stock prices. The data ranges from 3 January 2013 to 31 December 2015. To analyze the role of price discovery we were interested in utilizing the VECM model. A VECM is a special case of a VAR model which is only applied if the variables in a VAR model are non-stationary in their levels and are cointegrated at first difference. As such we started by conducting preliminary tests to determine the suitability of the VECM model. We started by developing a VAR model of this nature:
\[ S_t = \beta_0 + \beta_{11}S_{t-1} + \ldots + \beta_{1p}S_{t-p} + \beta_{21}ETF_{t-1} + \ldots + \beta_{2p}ETF_{t-p} + \epsilon_t^S \quad (1) \]

where \( S_t \) is the price of the stocks listed on the stock exchange, ETF is the price of the Exchange Traded Fund and \( \epsilon_t \) is the error term of the VAR model. The dependent variable \( S \) is expressed a linear function of the lags of itself and ETF, up to maximum lag \( p \). The maximum lag of this VAR model was determined using the Alkine Information Criterion.

We then performed a stationarity test using the Dickey Fuller Unit Root test to find out if the variables \( S \) and \( ETF \) are stationary in their levels. The Dickey Fuller Unit Root test was conducted using the maximum lag length of the underlying VAR model as suggested by the Alkine Information Criterion. If non-stationary in its first levels, the next step was to perform a cointegration test- to find out if the variables are cointegrated at first difference. We specifically used Johansen cointegration test to test if the variables are cointegrated at first difference. The cointegration test was performed on a remodelled VAR model of this form.

\[ \Delta S_t = \beta_0 + \beta_{11}\Delta S_{t-1} + \ldots + \beta_{1p}\Delta S_{t-p} + \beta_{21}\Delta ETF_{t-1} + \ldots + \beta_{2p}\Delta ETF_{t-p} + \epsilon_t^{\Delta S} \quad (2) \]

If the variables are found be non-stationary in their levels and cointegrated at first difference, and then the next step is to introduce a cointegration relationship/error correction term into the remodelled VAR equation and estimate the model as VECM. The VAR model changes to this form:

\[ \Delta S_t = \beta_0 + \alpha C \Delta \epsilon_{t-1} + \beta_{11}\Delta S_{t-1} + \ldots + \beta_{1p}\Delta S_{t-p} + \beta_{21}\Delta ETF_{t-1} + \ldots + \beta_{2p}\Delta ETF_{t-p} + \epsilon_t^{\Delta S} \quad (3) \]

where \( CE \) is the cointegration equation/error correction term introduced into the VAR model to make it a VECM model.

The error correction term in the model above measure the speed at which the ETF prices adjust to restore equilibrium in stock prices in the long term. In other words, its reveals the extent to which the ETFs help stocks achieve equilibrium prices in the long-run. A significant error correction term would therefore indicate that the ETF market play a significant role in the price discovery of stocks. Thus to confirm the role of ETFs in the model we tested the significance of the error correction term in the model.

**Results and Discussion**

We first conducted unit root test to find out price data for stocks and ETF is stationary at its level. We used the Augmented Dickey Fuller test to conduct the test at a maximum lag length of 3, which is the lag length for the underlying VAR model. The lag length of the underlying VAR model was determined using the Alkine Information Criterion. The results of the test are shown in the table below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lags</th>
<th>Test statistic</th>
<th>1% Critical value</th>
<th>5% Critical value</th>
<th>10% Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>3</td>
<td>-2.426</td>
<td>-3.430</td>
<td>-2.860</td>
<td>-2.570</td>
</tr>
<tr>
<td>ETF</td>
<td>3</td>
<td>-1.850</td>
<td>-3.430</td>
<td>-2.860</td>
<td>-2.570</td>
</tr>
</tbody>
</table>

We found out that both data series are non-stationary in their levels. We then conducted a Johansen cointegration test to find out if the variables are cointegrated at first difference.

To achieve that, we first test the null hypothesis that \( r=0 \) against the null hypothesis that \( r \) is greater than or equal to zero. Using the trace statistic, we rejected the null hypothesis that \( r=0 \) in favor of \( r \) is greater than 1. This confirmed that there exist at least one cointegration relationship between S and ETF. We then tested the null hypothesis that \( r=1 \) against the alternative hypothesis that \( r \) is greater than 1. Using the trace statistic, we accepted null hypothesis that \( r \) is equal 1. This confirmed the existence of one cointegration equation in the system. In other words, it revealed that the variables are cointegrated at first difference. The results of the Johansen cointegration test are shown below.
Since the variables are stationary at their first level and cointegrated at the first difference, we then introduced an error correction term and estimated the model as a VECM with one cointegration equation. The results of the estimated VECM are presented below:

**Table 3: Johansen Test for Cointegration**

<table>
<thead>
<tr>
<th>Maximum rank(r)</th>
<th>Parms</th>
<th>LL</th>
<th>Trace statistic</th>
<th>5% critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>-7474.6612</td>
<td>19.5493</td>
<td>15.41</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>-7446.3287</td>
<td>2.8843</td>
<td>3.76</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>-7464.8866</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Since the variables are stationary at their first level and cointegrated at the first difference, we then introduced an error correction term and estimated the model as a VECM with one cointegration equation. The results of the estimated VECM are presented below:

**Table 5: Estimated VECM**

<table>
<thead>
<tr>
<th>D_S</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>z</th>
<th>P&gt;z</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1.</td>
<td>-0.004728</td>
<td>0.0013005</td>
<td>-3.64</td>
<td>0.000</td>
</tr>
<tr>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LD.</td>
<td>-0.333477</td>
<td>0.0374778</td>
<td>-8.9</td>
<td>0.000</td>
</tr>
<tr>
<td>L2D.</td>
<td>-0.050485</td>
<td>0.0394158</td>
<td>-1.28</td>
<td>0.200</td>
</tr>
<tr>
<td>L3D.</td>
<td>0.0255249</td>
<td>0.0374557</td>
<td>0.68</td>
<td>0.496</td>
</tr>
<tr>
<td>ETF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LD.</td>
<td>-0.038976</td>
<td>0.0332343</td>
<td>-1.17</td>
<td>0.241</td>
</tr>
<tr>
<td>L2D.</td>
<td>-0.058218</td>
<td>0.0332282</td>
<td>-1.75</td>
<td>0.080</td>
</tr>
<tr>
<td>L3D.</td>
<td>-0.002189</td>
<td>0.0332192</td>
<td>-0.07</td>
<td>0.947</td>
</tr>
<tr>
<td>cons</td>
<td>1.374174</td>
<td>2.002172</td>
<td>0.69</td>
<td>0.492</td>
</tr>
</tbody>
</table>

Lastly, we analysed the significance of the error correction term using the p-value. The results indicate that the error term is negative and significant implying that there is a significant long-term relationship running from the ETF market to the spot market for stocks. In other words, the significance of the error correction term confirms the significance of the Beta Betta ETF in the price discovery of stocks listed on the BSE. To check the reliability of the findings, a diagnostic test for autocorrelation test was conducted on the VECM model using the Langrange test for autocorrelation. The model was found to be free of autocorrelation.

The results imply that the ETF is influencing the price discovery process of the underlying stocks. More specifically, the results imply that the Beta Betta ETF is significantly influencing the price discovery process of stocks listed on the Botswana Stock Exchange. This is likely due to the fact that liquidity levels of the Beta betta ETF has significantly improved since they were introduced, thereby increasing their ability to influence the prices discovery process of stocks. In other words, the results show that the Beta Betta ETF liquidity level is now large enough to significantly influence the price discovery process of stocks. As previously argued, the ability of liquid ETF markets to attract informed traders makes them an avenue to which information is disseminated to the market for the underlying stocks. What we are not sure is the extent to which the Beta Betta ETF dominates the underlying stock market in the price discovery processes. The results are likely to lead to the promotion of ETFs as an instrument that can improve the price discovery process of stocks especially in smaller illiquid stock markets like the Botswana Stock Exchange.

**Conclusion**

Being instruments that trade on underlying securities and considering the imperfect nature of financial markets, we argue that ETFs play a significant role in the price discovery of underlying stocks. As a result we expected the Beta Betta ETF which was introduced in March 2011 to be contributing significantly to the
price discovery of stocks listed on the Botswana Stock Exchange. In this study we empirically investigate if the Beta Betta ETF is indeed contributing significantly to the price discovery of stocks listed on the stock exchange. Using a VECM, the study revealed that the ETF is indeed playing a significant role in the price discovery of stocks. Considering the importance of efficient determination of prices in financial markets, the study findings are likely to result in further promotion of ETFs as a means to enhance price discovery in stocks markets. Further studies should focus on exploring the dominance of ETFs in the price discovery process of stocks.

References


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