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Operating Efficiency and A Test of Semi Strong Market Efficiency for Commercial Banks' Stock Price in Nepal

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Abstract

Stock market efficiency needs to be gauged on a regular basis as the development of stock market affects the level of economic growth in the economy. The level of stock market efficiency determines the investment strategy of the investors as well. The purpose of this study is to test the commercial bank stock price semi strong form of efficiency. This study found that commercial banks' stock prices are not semi form of market efficient. This study used the Data Envelopment Analysis (DEA) to examine the operational efficiency of the commercial bank. This study has used half yearly data of Nineteen periods to compute technical efficiency and its decomposition into pure and scale efficiency score of all Nepalese commercial banks and to test the semi form of market efficiency for commercial bank stock price. The operating efficiency score of the bank represents the public information for the current study. The current study used Arellano and Bover or Blundell and Bond model of dynamic panel regression to test the commercial stock price efficiency. This study found that change in log of lag one stock price and change in log of efficiency score can predict significantly the change in log of stock price. This implies that publicly available information has not been realized and adjusted in the current stock. This leads to the conclusion that Nepalese commercial bank stock price is not semi strong market efficient.

Keywords: DEA, market efficiency, Arellano and Bover, dynamic panel regression

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Introduction

Efficiency in the financial context can be broadly categorized into market efficiency and operating efficiency (Stiglitz, 1981 as cited in Beccalli, Casu & Girardone, 2006). Market efficiency refers to how quickly and accurately stock prices reflect available information (Ball, 1989). This concept forms the basis of the Efficient Market Hypothesis (EMH), which posits that prices adjust immediately to new information, thereby eliminating the possibility of consistently earning abnormal risk-adjusted returns (Fama, 1970 as cited in Degutis & Novikyte, 2014).

EMH is typically discussed in three forms: weak, semi-strong, and strong (Degutis & Novikyte, 2014). The semi-strong form, relevant to this study, asserts that stock prices reflect all publicly available information, such as financial statements, news, and announcements. As a result, neither fundamental nor technical analysis should yield excess returns (Sandhar, Nathani & Holani, 2009). Publicly available information—accessible at zero cost—must be incorporated into stock prices at the first trade following its release (Ball, 1989; Yen & Lee, 2008). Thus, in a semi-strong efficient market, any such information should be immediately reflected in stock prices.

While EMH is widely studied, its applicability in Nepal's stock market has shown mixed results. Studies such as Pradhan & Upadhyay (2006) and KC & Joshi (2005) concluded that the Nepalese market lacked weak-form efficiency. However, later studies (Misra, 2012; Dangol, 2016) showed some improvement. Regarding semi-strong efficiency, the evidence remains inconclusive and varies by type of public information. For instance, stock prices failed to reflect political events (Dangol, 2008) but did respond to dividend announcements (Dangol, 2012). Importantly, most past studies focused on broad market indices and specific events, with limited research on how operational performance metrics, such as bank efficiency, influence stock prices.

Operating efficiency, as conceptualized by Farrell (1957), refers to a firm's ability to produce more output from the same input or use fewer inputs for the same output. In the banking sector, this is often evaluated through technical efficiency, particularly when financial ratio analysis becomes inadequate due to the multi-input, multi-output nature of banking operations (Kumar & Gulati, 2008). Efficient operations should, theoretically, translate into greater profitability and stronger stock performance (Beccalli et al., 2006; Sufian & Majid, 2007a). Thus, if the market is semi-strong efficient, banks' operational efficiency should be reflected in their stock prices.

Traditional performance assessments such as financial ratio analysis (Yue, 1992; Thagunna & Poudel, 2013) are still used in regulatory contexts but often fall short due to inconsistency in ratio selection and applicability. More comprehensive approaches like Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis help overcome these limitations, particularly in measuring pure technical efficiency (managerial performance) and scale efficiency (optimal size of operation) (Chu & Lim, 1998; Banker, Charnes & Cooper, 1984 as cited in Kumar & Gulati, 2008).

If a stock market is truly semi-strong efficient, prices should process all publicly available information, including operational efficiency indicators. Otherwise, arbitrage opportunities may exist, contradicting EMH. This is particularly relevant in Nepal's capital market, where commercial banks alone account for 52.4% of total market capitalization (Nepal Stock Exchange Limited, 2025). Given this dominance, inefficiencies in pricing bank stocks can significantly distort the market and lead to misallocation of capital, potentially diverting investment away from more productive sectors (Borges, 2010; Regmi, 2012).

Moreover, the degree of market efficiency directly informs investment strategies. A semi-strong efficient market supports passive investing, as prices already reflect all relevant information (Malkiel, 2003). On the other hand, market inefficiency could incentivize active strategies based on exploiting informational gaps. Understanding the degree to which public information like operational efficiency is priced into stocks is therefore crucial for both investors and regulators.

While earlier studies in Nepal tested semi-strong efficiency using discrete events like political developments or dividend announcements (Dangol and Bhandari, 2019; Dangol, 2012; Khan & Ikram, 2010), this study takes a different approach. It uses banks' operational efficiency—a quantifiable, publicly available performance indicator—as the basis to examine whether Nepalese commercial bank stock prices reflect semi-strong form market efficiency.

Hence, this research seeks to answer the central question whether Nepalese commercial banking stock price depict semi-strong form of efficiency with respect to bank operational efficiency.

Hypothesis

The following hypotheses have been formulated to evaluate the impact of financial risk on stock return.

1. H_0: $H0$: Operational efficiency of Bank does not significantly affect stock prices. i.e There exists semi strong form of market efficiency.
   Under the semi-strong form of the Efficient Market Hypothesis (EMH), all publicly available information — including operational efficiency metrics like DEA scores — should already be reflected in stock prices. Therefore, if the market is efficient, operational efficiency should have no predictive power over stock price movements or levels. Any statistically significant relationship would suggest the market has not yet incorporated that information, implying inefficiency

Literature Review

Conceptual Foundation: Market Efficiency

Fama (1970) defined a market as efficient when security prices fully reflect all available information, thus enabling optimal allocation of resources (Fama, 1970, p. 2). Jensen (1978) further formalized this by introducing an information set θ_t, arguing that market efficiency implies no economic profit can be earned from trading based on θ_t if prices fully incorporate that information (Niarchos & Alexakis, 1998, p. 167). Formally, the expected price at time t+1, given θ_t, is: $\boldsymbol{E(\breve{p}_{j,t+1}|\theta_t) = [1 + E(\breve{r}_{j,t+1}|\theta_t)]p_{jt}}$ **(1)**

and deviations from that expectation,
$x_{j,t+1} = p_{j,t+1} - E(p_{j,t+1}|\theta_t)$ should have zero mean: $E(x_{j,t+1}|\theta_t) = 0$
Within this framework, three forms of EMH are defined (Jensen, 1978; Niarchos & Alexakis, 1998):

- Weak form: prices reflect historical price information only.
- Semi-strong form: prices assimilate all publicly available information (e.g., earnings, dividends), making fundamental or technical analysis ineffective.
- Strong form: even private, insider information is reflected in stock prices.

Early empirical work by Fama, Fisher, Jensen, and Roll (1969) on stock split events using event-study methodology, showed no abnormal returns post-split, lending support to semi-strong efficiency. In various markets, similar studies were conducted: Manasseh et al. (2016) found Nigerian markets efficient around bonus shares announcements, whereas Thathaiah & D'Souza (2013) found Indian earnings announcements did not align with efficiency.

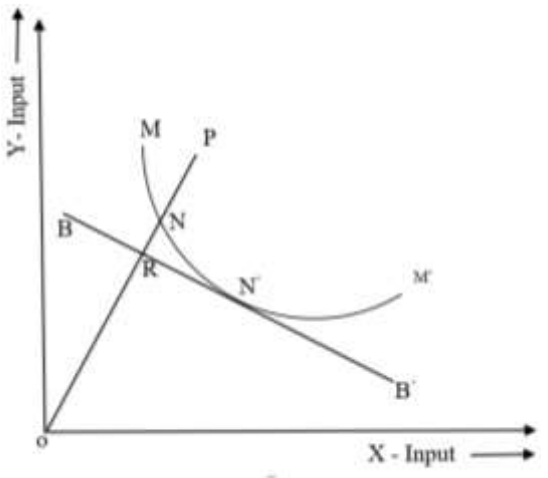
In the Nepalese context, Dangol (2012) found market adjustment to dividend announcements consistent with semi-strong efficiency, while Dangol (2008) showed markets did not respond to political shocks. Dangol & Bhandari (2019) further concluded that quarterly earnings announcements were not swiftly reflected in prices, suggesting persistence of inefficiencies.

Firms' Operating Efficiency

Farrell (1957) conceptualized firm efficiency through two components: technical efficiency (maximizing output from given inputs) and allocative efficiency (choosing input mixes given price vectors). Combined, they form economic efficiency. Technical efficiency is often depicted via isoquant analysis: the ratio ON / OP measures technical efficiency, and allocative efficiency is measured by OR / ON, as shown in his illustrative figure (Farrell, 1957, p. 254).

Figure 1

Overall Economic, Technical and Allocative Efficiency



Source: Farell (1957, p.254)

In banking, traditional financial ratios (e.g., cost ratios, ROA, ROE) have widely been used to assess performance (Chen & Yeh, 1998; Bauer et al., 1998; Wozniewska, 2008). While easy to compute, ratio analysis is limited in multi-input, multi-output settings and lacks a unified frontier against which performance can be benchmarked.

Alternatively, parametric methods—such as Stochastic Frontier Analysis (SFA), Thick Frontier, and Distribution-Free Approaches—impose functional forms and distributional assumptions (Alber et al., 2019; Tuskan & Stojanovic, 2016; Burger & Humphrey, 1997). Non-parametric frontier techniques, notably Data Envelopment Analysis (DEA) introduced by Charnes, Cooper & Rhodes (1978) and Free Disposal Hull (FDH, Desprins et al., 1984), offer flexibility: no form or distribution assumptions, ability to handle multiple inputs and outputs, and consistent benchmarking (Banker et al., 1988 as cited in Habibullah et al., 2005).

DEA produces efficiency scores—overall technical efficiency (CRS), pure technical efficiency, and scale efficiency —allowing decomposition of inefficiency sources (Lee, 2009; Abel & Bara, 2017). Studies across diverse contexts have successfully measured bank efficiency using DEA: Feroz et al. (2003) in oil & gas, Chen & Yeh (1998) for Taiwanese banks, Ally (2014) for Tanzanian banks, Berg et al. (1991) in Norway, and Sardar et al. (2011) for Pakistani Islamic banks.

In Nepal, Thagunna & Poudel (2013) applied DEA using an intermediation approach—inputs like deposits, interest and non-interest expenses; outputs like loans, interest income, non-interest income—and found efficiency scores stable and improving over time.

Linking Operational Efficiency and Market Pricing

Evidence across several economies suggests a relationship between operational efficiency and stock returns, contradicting semi-strong EMH. Beccalli et al. (2006) analyzed five European banks and found cost-efficiency changes derived from DEA/SFA significantly explained stock price changes. Chu & Lim (1998) showed in Singapore that profit efficiency was reflected in share price movements. Similarly, Aftab et al. (2011) in Pakistan and Alam & Sickles (1998) in the U.S. airline industry found that technical efficiency predicted stock returns, challenging the notion that publicly available information is fully priced in.
Erdem & Erdam (2007) explored Turkish banks and concluded that stock prices were efficient in reflecting publicly known efficiency data using pooled regression. Conversely, Habibullah et al. (2005) applied DEA along with Granger causality tests to Malaysian bank stock prices and found that technical efficiency—but not pure technical or scale efficiency—was reflected in share prices, indicating partial inefficiency. Pasiouras et al. (2008) also found that Greek bank stock performance could be predicted by technical efficiency, suggesting semi-strong inefficiency in that market. Sufian & Majid (2007b) similarly demonstrated that profit efficiency influenced share price movement among Malaysian banks.

Synthesis and Research Impetus

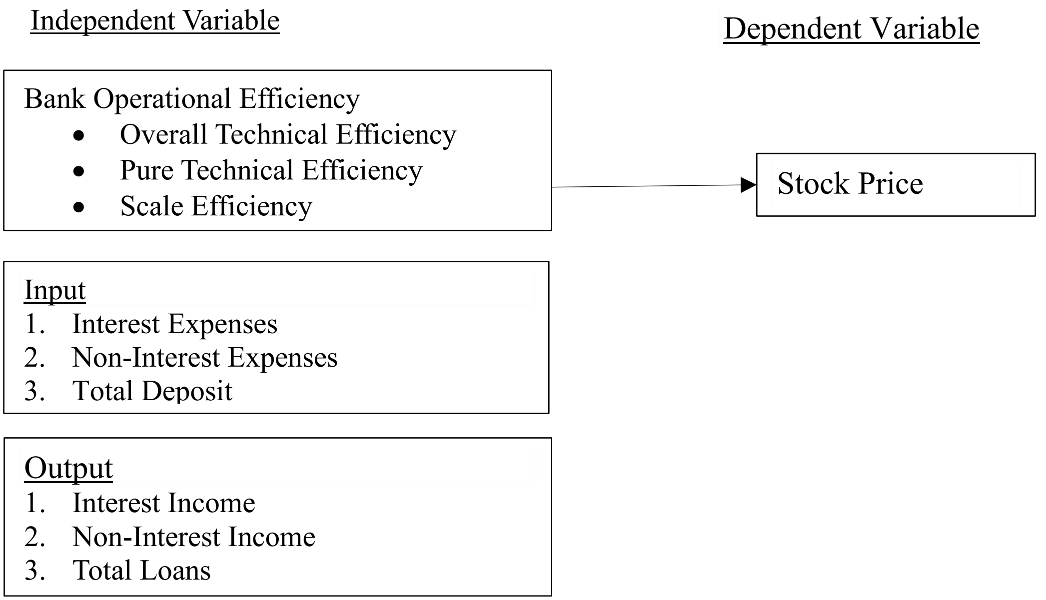
The empirical literature shows mixed findings across countries regarding semi-strong market efficiency when operational efficiency is used as the information set. Some studies find full adjustment of prices, while others find persistent mispricing tied to efficiency scores.

In Nepal, though bank efficiency via DEA has been studied, its integration into market pricing mechanisms has not been examined. This study addresses that gap by testing whether DEA-based operational efficiency scores (CRS, VRS, scale) of Nepalese commercial banks are reflected in their stock prices—thus offering novel empirical evidence on semi-strong market efficiency in a banking-dominated emerging market

Conceptual Framework

Figure 2

Conceptual Framework for Impact of Bank Efficiency on Stock Price



Research Design

The current study has taken the positivist approach to investigate research issues. And therefore, the quantitative approach and the causal research design have been used. The deductive approach to theory testing underpinned the current study. Dynamic Panel data regression has been used to test the existence of semi-strong market efficiency.

Data Envelopment Analysis as a Measure of Operational Efficiency

Data Envelopment Analysis is a linear programming tool which is used to assess the performance of the firms. These firms are decision making unit (DMUs) (Ramananthan, 2003). DEA provide the metric which indicate how successful a particular DMU is for utilizing the resource to produce the organizational output (Ramanathan, 2003). DMU can be service provider, manufacturer or producer. Under DEA, the observation of output and input of each DMU is taken. Based on the input and output of each DMU, the best DMU, which could be virtual DMU as well, is chosen and it acts as benchmark against which the efficiency of each DMU is computed. DEA assumes that if a particular DMU say "A", is able to produce Z(A) units of output using X(A) inputs, then it is necessary that other DMU should also able to produce the same level of output if they were to remain operational efficient.

DEA model in linear programming form will be as:

Objective Function:

$$\text{Maximize } \theta_m = \frac{\sum_{j=1}^{J} v_{jm} Y_{jm}}{\sum_{i=1}^{I} u_{im} X_{im}}$$

Subject to

$$0 \le \frac{\sum_{j=1}^{J} v_{jm} Y_{jn}}{\sum_{i=1}^{I} u_{im} X_{in}} \le 1 \quad ;\text{n} = 1, 2, .. \text{K, N}$$

$u_{im}, v_{jm} \geq 0$; i =1, 2, K, I; j=1, 2, K, J

Standard form in LP

Objective Function:

$$\text{Maximize } \theta_m = \sum_{j=1}^{J} v_{jm} Y_{jm}$$

Subject to

$$\sum_{i=1}^{I} u_{im} X_{im} = 1 \quad ;\text{n} = 1, 2, .. \text{K, N}$$

$$\sum_{j=1}^{J} v_{jm} Y_{jn} - \sum_{i=1}^{I} u_{im} X_{in} \le 0$$

$\text{n} = 1, 2, .. \text{K, N}$

$u_{im}, v_{im} \geq 0$; i =1, 2, K, I; j=1, 2, K, J

θ_m is overall technical efficiency ($0 < \theta_m \le 1$)
Y_{jm} is the j^{th} output of m^{th} DMU being evaluated
v_{jm} is the weight of that output
X_{im} is the i^{th} input of m^{th} DMU being evaluated
u_{im} is the weight of that input
j = number of output index
i= number of input index
Y_{jn} and X_{in} are jth output and i^{th} input, respectively, of the n^{th} DMU, n = 1, 2, …, N.
Note that here n includes m

The DMU having $\theta_m = 1$ is considered as the efficient DMU and the DMU having $\theta_m < 1$ is considered as inefficient DMU. The above model is Charnes, Cooper and Rhodes (CCR) model which assumed of Constant Return to Scale (CRS). When the increase in input leads proportionate increase in output that is percent change (increase/decrease) in input is equal to percent change in output (increase/decrease), it is termed as CRS. The size of each DMU does not matter to compute technical efficiency score under CRS assumption (Alrashidi, 2015).

In a real case, there are number of factors which affect the operations of the DMU due to which it might not possible to operate on an optimum scale. Hence, the question may rise on realistic implication of CRS assumption. The CCR model cannot identify the reason for inefficiency which may be due to managerial failure to resource utilization (Pure technical efficiency) or incorrect size of operation (Scale Efficiency). Banker, Charnes and

Cooper (1984) overcome this limitation by taking the variable returns to scale (VRS) assumption which takes into account of pure technical efficiency.

The BCC model adds an unconstrained scalar variable α to the CCR model as follows:

Standard form in LP

Objective Function:

$$\text{Maximize } \gamma_{\mathrm{m}} = \sum_{j=1}^{J} v_{jm} Y_{jm} - \alpha_m$$

Subject to

$$\sum_{i=1}^{I} u_{im} X_{im} = 1 \quad ; \mathrm{n} = 1, 2, .. \mathrm{K}, \mathrm{N}$$

$$\sum_{j=1}^{J} v_{jm} Y_{jn} - \sum_{i=1}^{I} u_{im} X_{in} - \alpha_m \leq 0$$

$\mathrm{n} = 1, 2, .. \mathrm{K}, \mathrm{N}$

$u_{im}, v_{im} \geq 0$; i =1, 2, K, I; j=1, 2, K, J

α_m is free of mathematical sign

γ_{m} is pure technical efficiency (PTE)

$$SE = \frac{OTE}{PTE}$$

The Choice of the DEA Model to Evaluate Bank Efficiency

This study used DEA approach for the computation efficiency score of bank consisting of scale and pure technical efficiency along with overall technical efficiency. The DEA model has several advantages to evaluate bank operational efficiency. DEA can handle multiple input and output at the same time. Similarly, the functional specification is not required. It is more practicable as it performs check against actual benchmark (Habibullah et at., 2005).

Moreover, DEA has been applied to assess the performance of the financial institutions is used to evaluate bank performance and which is considered to be superior to ratio analysis on different aspect. The reason why DEA is better than ratio analysis is due to the limited agreement among the scholars and researcher for the ratio analysis to portray the complete analysis of the firm. For instance, when a particular ratio is used it may indicate firm A may be better, but when some other ratios are considered firm B could be better resulting into conflicting conclusion regarding the financial performance of a firm (Ho & Zho, 2004). Another reason for using DEA to measure the efficiency of the firm is due to the inherent limitation of ratio analysis which consider single input and output by the firm. However, in practice the firms might use multiple input and generate multiple output. Further, the single ratio cannot portrait the complete picture of the firm and cannot cover all the dimension of the performance metric. Hence, ratio selection become an issue for the evaluator (Chen, 2002. Aggregation of multiple ratios could be a way out. However, it suffers from limitation as weighting the different ratio arbitrarily renders the result unreliable (Shammari & Salimi, 1998). The DEA method allows the multiple criteria for evaluation of the output of the firm. DEA requires only data on the quantity of inputs and outputs to compute the technical analysis and does not require price information due to which it is popular for evaluation of bank efficiency (Yue, 1992).

Choice of Input-Output variable for DEA

There are primarily two approaches to measure the input and output for banking institution. The production approach assumes banks produces services for their accountholders. Based on this method, the output is computed by volume of the account and categorization of different transactions (both deposits and loans). Similarly, input consist of quantity of labor and capital. However, such data is not easily available and cannot be found in financial reports (Berger & Humphrey,1997; Pant & Bedari, 2015). Another frequently used approach is intermediation approach which takes into account of fund transfer activity from savers to investors (Berger & Humphrey,1997). This approach considers Deposit and cost of deposit (interest) and other cost (non interest) as the input which will converted into loan and investment as output and return those output. The intermediation method is considered more practical and suitable for assessing the banking organization (Berger &Humphrey,1997). This study has also taken the intermediation approach of banking for to choosing the input variable and output variable following Berger and Mester (1997); Habibullah et al., 2005; Thagunna and Poudel, 2013; Pant and Bedari, 2015. Hence, the study has taken interest income (Y1), operating non-interest income (Y2) and total loans (Y3) as output and interest Expenses (X1), Operating Non- interest Expense (X2) and Total Deposit (X3) as input.

Interest Income (Y1): It consists of interest received on loans and advances, interest from investment on securities, bonds and interbank lending, interest on agency balance (local and foreign banks) and Others (interest on certificate of deposit and inter bank loan).

Operating Non-Interest Income (Y2): It consists of income from commission and discount, exchange fluctuation gains and other operating income (such as service fee, renewal fee etc).

Total Loans (Y3): It consists of loan and advances disbursed by the bank which include real estate loan, personal home loan, margin loan, term loan, overdraft and others.

Interest Expenses (X1): It consists of interest paid on deposit liabilities, borrowings and other interest paying liabilities.

Operating Non- Interest Expense (X2): It consists of staff expenses, commission expenses and other operating expenses.

Total Deposit (X3): It consists of deposit liabilities form interest bearing and non-interest-bearing accounts. Interest bearing deposit include saving, fixed, call and certificate of deposit. Non-interest-bearing deposit include current deposit, margin deposit and others.

All the input and output variables have been taken from income statement and balance sheet of the respective bank published by Nepal Rastra Bank's monthly banking and financial statistics report.

Unit of Analysis

Individual banks are the unit of analysis for computing efficiency score. Hence, both unit of observation and unit of analysis is individual bank for efficiency score. However, commercial bank as a group is the unit of analysis when efficient market hypothesis testing has to be done. Here, the unit of observation is individual bank, but the unit of analysis is all the commercial banks as a group.

Data Collection and Sources of Data

The secondary data are collected from half yearly financial statements of 19 semi annuals from July 2015 to Jul 2024 were used to collect the relevant variable information for the study. The stock data was not available for several periods for several banks prior to 2015 due to the merger movement in banking industry. The information relating to independent variables, namely interest expenses, interest income, operating non-interest income, operating non- interest expense, total deposit and total loan were taken from half yearly financial statements. Commercial banks' financial statements were retrieved from Nepal Rastra Bank website. Similarly, the information relating to dependent variable, stock price, was collected from Nepal Stock Exchange website and Share Sansar. The data is unbalanced panel data.

Population and Sample

The population of the study is all commercial banks operating in Nepal for the purpose of this study. The homogeneity of DMU is required to work on the DEA model effectively. Hence, the data have been collected considering homogeneity in terms of business operation and resources. Hence all the commercial banks have been taken to compute the efficiency score. However, Rastriya Banijya Bank has been left out from analyzing market efficiency. Rastriya Banijya Bank has not made public stock offering till date. Hence, all commercial banks, but Rastriya Banijya Bank were used for analysis.

Data Analysis Strategy

The current study used DEA method to derive technical efficiency of the commercial banks to reflect operational efficiency of the bank. The study used DEAP 2.1 software to compute technical efficiency, pure technical efficiency and scale efficiency score of the commercial banks to represent operational efficiency.

Thereafter, the current study has used dynamic panel regression to analyze and test the market efficiency of commercial banks' stock prices.

Dynamic Panel Model

The present study used dynamic panel regression model to test the semi-strong form of efficiency. The semi-strong form EMH states that stock price represents both past information and publicly available information that neither past data nor public information can predict the stock price. The model has been specified as below

$\Delta log\ SP_{i,t} = \alpha + \beta \Delta log\ SP_{i,t-1} + \gamma \Delta logEff_{i,t} + \varepsilon_{i,t}$ --- (I)

Where,

SP = Stock Price of commercial bank; Eff= Efficiency score of the bank ($0<Eff\leq1$; Higher the value, the more efficient the bank is)

Ordinary Least Squares or pooled regression assumes the absence of panel nature of the data in analysis due to which the beta coefficient is upward biased for the lagged dependent variable in the presence of unobserved heterogeneity (Bond, 2002 as cited in Flannery & Hankins, 2012). Fixed effects model can overcome unobserved heterogeneity issues. However, fixed-effects estimation is a static panel data model and inclusion of the lag of the dependent variables as an explanatory variable in the econometric model is not allowed (Wooldridge, 2012). Further. Fixed Effects model ignores the correlation between the lagged dependent variable and the regression error. And Hence, Fixed effects yield a downward-biased coefficient estimate for the lagged dependent variable (Nickell,1981 as cited in Flannery & Hankins, 2013).

The model for the current study used the lagged dependent variable (past stock price) as an explanatory variable. The lag dependent variable included in model changes the static nature of econometric model to a dynamic panel data model. Two-step system GMM can handle the dynamic panel data model. GMM model controls for endogeneity with the internal transformation of the data and inclusion of lagged values of the dependent variable (Ullah, Akhtar & Zaefarian, 2017). System GMM regression produces consistent and efficient parameters that are robust to the biases and inconsistencies caused by omitted variables, simultaneity and dynamic endogeneity (Abdallah, Georgen & Sullivan, 2015). In this way, the GMM model offers a more efficient, consistent and superior estimation. System GMM also takes care of heteroscedasticity and autocorrelation in addition to endogeneity issue (Baum & Schaffer, 2002). The current study used Arellano and Bover or Blundell and Bond (BB) GMM model for dynamic panel regression. GMM estimation require the cross section/number of group (N) > time dimension (T), the residuals to be free from second-order and above serial correlation and number of instruments < Number of cross-section. Arellano -Bond test of autocorrelation has been used to test the second order correlation. BB model outperforms OLS and fixed effects (FE) estimators when the regression residuals are uncorrelated (Flannery & Hankins, 2013).

When applying GMM model, we need to apply two post estimation test to determine that appropriate econometric model is applied. These tests are Sargen test and arellano bond test for first order and second order correlation (Ullah, Akhtar & Zaefarian, 2017). The critical assumption for validity of GMM estimation requires that instruments are exogenous. Sargan test have been employed to check the validity of the instrument used in the current model. If the sargan test turns out be insignificant, then it implies the instrument included in the econometric specification are exogenous. Arellano-bond test for first order and second order correlation has been employed to examine the validity of strong exogeneity. No serial correlation means that lagged variable is not correlated with the error term (Ullah, Akhtar & Zaefarian, 2017).

In the equation I if the coefficient of $\Delta log\ SP_{i,t-1}$is found to significant (positive or negative) then it implies that historical price has effect on current price which is against the weak form efficiency. Similarly, if the coefficient of $\Delta log\ Eff_{i,t}$ is found to be significant then it implies efficiency score have effect on current price which means public information has not been accommodated fully in current price which is against semi-strong form efficiency. If semi strong form efficiency is to hold then both past information and public information need to be reflected by current price that is coefficient of $\Delta log\ SP_{i,t-1}$ and $\Delta log\ Eff_{i,t}$ should come insignificant.

Hence, the current study used BB model to estimate the equation I and test the research hypothesis. STATA software version13 have been used for data analysis.

Unit Root Test of Panel Data Stationary

Unit root analysis needs to be carried out in order to check the data stationary for the time series component. Data needs to be stationary before carrying out the regression analysis, else there is a possibility of spurious regression and persistence of shock for infinite period. If the variables in the regression model are not stationary standard assumption for asymptotic analysis will not be valid.

The unit root test for the log of stock price and log of efficiency score were carried out using Fisher-type Phillip-Perron of panel data unit root test as the structure of data is unbalanced panel.

Table 1

Fisher –Type Phillip Perron Unit-Root Test for Change in Log of Stock Price (ΔlnSP) and Change in Log of Efficiency (ΔlnEff)

Ho: All Panels contain unit roots

Ha: At least one Panel is stationary

			TE	PTE	SE
		Statistic (P- Value)	Statistic (P- Value)	Statistic (P- Value)	Statistic (P- Value)
Inverse chi-squared	P	655.19 (0.000)	1402.01 (0.000)	1059.40 (0.000)	1396.82 (0.000)
Inverse normal	Z	-21.84 (0.000)	-34.62 (0.000)	-29.35 (0.000)	-34.12 (0.000)
Inverse logit	L*	-34.87 (0.000)	-74.65 (0.000)	-57.48 (0.000)	-74.37 (0.000)
Modified inv. chi-squared	Pm	57.84 (0.000)	129.71 (0.000)	96.74 (0.000)	129.31 (0.000)

Source: Researcher's estimation

Table 1 The unit root test for the log of stock price and log of efficiency score has been carried out using Fisher-type Phillip-Perron of panel data unit root test as the structure of data is unbalanced panel. The change in log of variable has been taken to render the stationarity in the data. The null hypothesis that panel contain units cannot be accepted at 5% level of significance as p-value (0.000) < 0.05. Hence, we can conclude change in log of efficiency (Operational efficiency and its decomposition) and change in log of stock price are stationary.

Since the stationary condition of data set of both variables (independent and dependent) has been met, the regression analysis can be carried out.

Dynamic Panel Data Regression and Hypothesis Testing

This study have the following model specification for testing the efficient market hypothesis.

$$\Delta log\ SP_{i,t} = \beta_o + \alpha_i + \beta_i \Delta log\ SP_{i,t-1} + \gamma \Delta logEff_{i,t} + \varepsilon_{i,t} \text{ ------------------------------(II)}$$

Arellano and Bover or Blundell and Bond (BB) model of dynamic panel estimation have been used for this study. First model was estimated and then sargen specification test followed by Arellano-Bond test for autocorrelation in first difference error have been undertaken. Finally heteroscedasticity error corrected robust model have been carried out.

Table 2

Arellano/Bover or Blundell and Bond for a Dynamic Panel Model

Independent variable	Overall Technical Efficiency		Pure Technical Efficiency		Scale Efficiency	
	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
Constant	-0.0807	0.000	-0.079	0.000	-0.80	0.000
$\Delta log SP_{i,t-1}$	-0.3497	0.000*	-0.367	0.000*	-0.346	0.000*
$\Delta log Eff_{i,t}$	-1.127	0.000*	0.848	0.000*	0.283	0.000*
Wald Test for Significance of Variable in the Model						
Wald Chi2	6608.41	0.000*	4918.0	0.000*	7109.98	0.000*

*Note: * p<0.01, ** p<0.05*

Source: Researcher's estimation

The table 2 shows that the coefficient of change in log of lag dependent variable that is change in log of first lag Stock price is significant under all category of efficiency. Similarly, the coefficient of change in log of independent variable that is change in log of efficiency is significant under all category of efficiency. Hence, past stock price have an impact on present stock price under all category of efficiency. Similarly the bank efficiency (overall efficiency, managerial efficiency and correct size of operation) have also an impact on stock price. The result can be stated in terms of research hypothesis as under:

H_0: $\beta_1 = \gamma = 0$ i.e there exist semi strong form of market efficiency

H_1: β_1 or $\gamma \neq 0$ i.e there exist semi strong form of market inefficiency

Since, the p-value for all the individual coefficient and for the model as a whole is less than 0.05, we cannot accept the null hypothesis that there exist semi strong form market efficiency. The semi form of market efficiency require that neither past price nor the public information can predict the stock price. Hence, in this sense, we can conclude that there is semi strong form of market inefficiency for the stock price of commercial banks.

However, we need to check other parameter to accept the result from the model. Hence, model specification test and autocorrelation test need to be carried. Model specification test have been carried out with Sargen test of over identification and Arellano-Bond test for zero autocorrelation in first-differenced errors have carried out.

Table 3

Sargan Test of Over Identifying Restrictions

H_0: Over Identifying Restrictions are Valid			
	Overall Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
chi2	26.313	26.448	26.10
Prob > chi2	0.9913	0.9908	0.920

Source: Researcher's estimation

The output above presents evidence in favor of null hypothesis that the over identifying restrictions are valid and cannot be rejected as p value is greater than 0.05. The instruments are determined to be ok. Rejection of the null hypothesis can mean that the instruments are either correlated with errors or that there are omitted variables in the model. In either case, the model as estimated is mis specified. But the case is reverse and hence, the model specification is correct.

Table 4

Arellano-Bond Test for Zero Autocorrelation in First-Differenced Errors

H_0: No Autocorrelation						
Order	Overall Technical Efficiency		Pure Technical Efficiency		Scale Efficiency	
	Z	Prob>Z	Z	Prob>Z	Z	Prob>Z
1	-4.066	0.000	-4.1072	0.0000	-3.9672	0.0001
2	-0.356	0.916	-0.10334	0.9177	-0.0858	0.9316

Note. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: Researcher's estimation

The model (II) requires that residuals are free from second-order serial correlation. This can be tested using Arellano-Bond test for zero autocorrelation which is presented in table 4. The table 4 shows that there exist serial correlation for the first order difference error as p-value is less than 0.05 and null hypothesis that there is no autocorrelation cannot be accepted. However, for second order difference error p-value is greater than 0.05 for efficiency and hence, null hypothesis that there is no autocorrelation can be accepted.

Since, there exist second order autocorrelation and the model result presented in table 10 suggested the standard error biasness for overall technical efficiency.

Robust Standard Error Model

Table 5

Arellan/Bover or Blundell and Bond for a Dynamic Panel Model (Robust)

Independent variable	Overall Technical Efficiency		Pure Technical Efficiency		Scale Efficiency	
	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
Constant	2.117	0.000	2.1579	0.000	2.12	0.000
$\Delta log SP_{i,t-1}$	0.1406	0.000^*	0.628	0.000^*	0.633	0.000^*
$\Delta log Eff_{i,t}$	0.6349	0.000^*	0.107	0.000^*	0.259	0.256
Wald Test for Significance of Variable in the Model						
Wald Chi2	88.08	0.000^*	62.43	0.000^*	67.66	0.000^*

Source: Researcher's estimation

Note: * $p<0.01$, ** $p<0.05$,

Similarly, autocorrelation test for error has been carried out for robust model as well presented in table 6.

Table 6

Arellano-*Bond Test for Zero Autocorrelation in First-Differenced Errors*

H_0: No Autocorrelation						
Order	Overall Technical Efficiency		Pure Technical Efficiency		Scale Efficiency	
	Z	Prob>Z	Z	Prob>Z	Z	Prob>Z
1	-4.1011	0.000	-4.202	0.000	-4.05	0.000
2	3.515	0.054	3.36	0.105	2.96	0.077

Source: Researcher's estimation

Table 5 shows that with robust estimate after controlling for heteroskedasticity standard error. The result of robust model is consistent with earlier model. The serial correlation for the difference error has been eliminated as p-value is greater than 0.05 and null hypothesis that there is no autocorrelation can be accepted as depicted in table 5.

Both the model (table 2 and table 5) show that there is no evidence of semi form of market efficiency for commercial bank stock price. The model has passed through the specification test and error test and hence, we can rely on the result presented above.

Discussions

The semi-strong form of the Efficient Market Hypothesis (EMH) posits that stock prices fully reflect all publicly available information, including past prices and financial disclosures. In this study, the efficiency scores of Nepalese commercial banks—representing publicly available information—were analyzed to determine whether they are incorporated into stock prices. The findings indicate that the stock prices of these banks are semi-strong form inefficient, as they are influenced by both past prices and efficiency scores. This inefficiency suggests that the market does not fully and immediately incorporate public information into stock prices, allowing for the possibility of abnormal returns through predictive modeling.

These findings are consistent with the results of Habibullah et al. (2005), who reported semi-strong inefficiency with respect to overall technical efficiency. However, the present study expands this by showing inefficiency with regard to pure technical and scale efficiency as well, which Habibullah et al. did not find. On the other hand, the results contradict those of Erdem and Erdem (2007) and Fat and Hua (1998), who found stock prices to be semi-strong form efficient. Notably, those studies were conducted in more developed or emerging markets such as Turkey, Singapore, and Malaysia, whereas this study focuses on Nepal—a least developed country. The discrepancy in findings may stem from

Nepal's market maturity and structural characteristics including market structures, regulatory environments, and investor behavior across different economic contexts.

Furthermore, this study adopts a more rigorous approach and employe more advanced econometric approach than prior research. Specifically, it utilizes dynamic panel regression (Blundell and Bond estimator) that incorporates lagged dependent variables to control for endogeneity and autocorrelation—issues that commonly bias results in stock price modeling. Previous studies employed less robust methods, such as event studies (Sandhar, Nathani & Holani, 2009), linear regression (Khan & Ikram, 2010), pooled regressions (Fat & Hua, 1998; Sufian & Majid, 2007; Erdem & Erdem, 2008), and Granger causality (Habibullah et al., 2005), which may suffer from model misspecification and biased estimates. Unlike the Granger causality model of Habibullah et al., this study regressed the change in log stock price on lagged log stock prices and log efficiency scores directly, while carefully addressing issues of specification error and endogeneity. Ultimately, the results suggest that past stock prices possess predictive power over future prices, contradicting EMH. While the conclusions are statistically robust, future research is encouraged to validate these findings using longer time series and different data granularities.

Conclusion

The study provides strong evidence that Nepalese commercial bank stock prices do not fully reflect publicly available information, including operational efficiency metrics and past price movements. The statistically significant influence of lagged stock prices and DEA-based efficiency scores on current stock prices suggests that market participants are either slow to process available information or that information asymmetry persists. These findings challenge the semi-strong form of market efficiency in Nepal's banking sector and underscore the need for greater transparency, investor awareness, and regulatory oversight to enhance market responsiveness and capital allocation efficiency.

The findings provide valuable insights for investors and policymakers to make informed decisions, highlighting the need for robust risk management practices and the consideration of broader economic conditions.

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