“Selection of the right proxy market portfolio for CAPM”

AUTHORS	Rashmi Chaudhary Priti Bakhshi

ARTICLE INFO	Rashmi Chaudhary and Priti Bakhshi (2021). Selection of the right proxy market portfolio for CAPM. *Investment Management and Financial Innovations*, *18*(3), 16-26. doi:10.21511/imfi.18(3).2021.02
DOI	http://dx.doi.org/10.21511/imfi.18(3).2021.02
RELEASED ON	Tuesday, 27 July 2021
RECEIVED ON	Friday, 14 May 2021
ACCEPTED ON	Tuesday, 06 July 2021
LICENSE	This work is licensed under a Creative Commons Attribution 4.0 International License
JOURNAL	"Investment Management and Financial Innovations"
ISSN PRINT	1810-4967
ISSN ONLINE	1812-9358
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
38	0	6

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Rashmi Chaudhary (India), **Priti Bakhshi** (India)

SELECTION OF THE RIGHT PROXY MARKET PORTFOLIO FOR CAPM

Abstract

The purpose of the paper is to select the right market proxy for calculating the expected return, since critically evaluating proxies or selecting the correct proxy market portfolio is essential for portfolio management because the change in the market portfolio proxy affects returns. In this study, monthly data of equity indices are evaluated to find out the better market proxy. The indices taken are BSE 30 (Sensex), Nifty 50, BSE 100, BSE 200, and BSE 500. The macroeconomic variables used in the study are industrial production index (IIP), consumer price index (CPI), money supply (M1), and exchange rate in India. To avoid the influence of COVID-19, the research period was from January 2013 to December 2019 to critically evaluate these proxies in order to find the most appropriate market proxy. This paper reveals a noteworthy relationship between stock market returns and macroeconomic factors, while suggesting that the BSE 500 is a better choice for all equity indices, as the index also shows a significant relationship with all macroeconomic variables. BSE500 is a composite index comprising all sectors with low, mid and large cap securities, therefore it reflects the impact of macroeconomic factors most efficiently, taking it as a market proxy. This study was carried out in the context of India and can be replicated for other countries.

Received on: 14th of May, 2021
Accepted on: 6th of July, 2021
Published on: 27th of July, 2021

Rashmi Chaudhary, Associate Professor, Faculty of Management, Department of Finance, Jaipuria Institute of Management Lucknow, India.

Priti Bakhshi, Ph.D., Associate Professor, Faculty of DBA, S P Jain School of Global Management, India. (Corresponding author)

Conflict of interest statement:
Author(s) reported no conflict of interest

Keywords portfolio management, market proxy, emerging markets, macro-economic, volatility, vector error correction model, composite index

JEL Classification C58, E44, G11, G12, G14

INTRODUCTION

It is known that one of the most profitable return markets with the highest volatility is the capital market (Abugri, 2008). Capital markets in emerging economies are more volatile than in developed economies, so they are more sensitive to changes in macroeconomic factors (Chaudhary et al., 2020). Thus, the relationship between macroeconomic factors and stock returns is always of high interest both for academicians and practitioners. To get the desired high return from the capital market, first thing that any investor does is to follow the market index. Market index can be an equity-only market portfolio (composite equity index) or it can be a value weighted portfolio of all assets. Composite index is a market index covering major sectors that changes as per the directions of changes in macroeconomic factors (upward/downward based on favorable/unfavorable change in macro-economic factors), which is not necessary in the case of a sectoral index (Maysami & Rahmat, 2005). The composite index can be the yardstick to evaluate the performance of investments in the capital market and helps investors predict future returns (Ibrahim & Aziz, 2003). In the CAPM model, market indices are used as a market proxy. Sicne an emerging economy like India does not have a value weighted portfolio of all assets, so equity-only market portfolios are taken in the CAPM Model. In India, commonly used proxies for the underlying market portfolio are BSE 30, Nifty 50, BSE 100, BSE 200, BSE 500, etc.

http://dx.doi.org/10.21511/imfi.18(3).2021.02

for asset pricing. The BSE 30, Nifty 50 and BSE 100 mainly consist of large-cap organizations resulting in an unbalanced inclusion of large enterprises (Indices & Jones, 2019). The composition of the BSE 30, Nifty 50, and BSE 100 results in a large-cap bias increasing the likelihood of distorted calculations of the systematic risk. The market beta of small-cap organizations is, on average, larger than the market beta of large-cap organizations as these corporations reflect a riskier investment (Asness et al., 2018). Since the BSE 30, Nifty 50, and BSE 100 only contain large-cap firms, estimated returns reflect the systematic risk of small firms limitedly. The same holds for the BSE 200, since the BSE 200 index mainly consists of large-cap and mid-cap companies (SEBI). Besides a large-cap bias, other distortions (e.g., momentum bias) are conceivable to occur when using a single index, which only replicates a fragment of the market. Such biases can be mitigated by expanding the underlying the stock universe of various indices. BSE 500 consists of 1-100 large cap companies, 101-250 mid-cap companies and 251-500 small cap companies in terms of full market capitalization (SEBI). Due to the presence of biases in different indices, an empirical study is required to find the market proxy.

Economic indicators are frequently used to predict future economic activity, performance of financial markets and exchange rates. Macroeconomic data is used by investment professionals to predict the earnings potential of companies and to find which asset classes can be more attractive. But at the same time, it cannot be denied that the gap between the economy and stock market widened during the crisis. Recently, in the COVID times, equity indices are not able to mirror the economy, and the debate about the stock market-economy gap has generated more heat than light. It brings us back to the question of whether the index really reflects the ground reality, and the quantification of the same is an empirical question. Furthermore, this question is a pertinent one, as the choice of a market portfolio proxy is very important in a capital asset pricing model.

1. LITERATURE REVIEW

If the indices are associated with macroeconomic factors, any fluctuation in the factor can affect market volatility. Market volatility is strongly associated with different variables such as stocks performance, information sharing, trading frequency, small cap and large cap stock portfolio, macroeconomic factors, etc. (Banz, 1981; Reinganum, 1981; Varamini & Kalash, 2008). Fluctuations in emerging markets like India (Chaudhary et al., 2020), as well as volatility in the international stock market (Chaudhary et al., 2020), plays an important role in stock returns because within macroeconomic factors, local factors and global factors may have different impact on returns (Griffin, 2002; Bruner et al., 2008; Fama & French, 2012; Cakici, 2015).

According to the Efficient Market Hypothesis (EMH), all significant information related to variations in macroeconomic factors is fully imitated in the existing stock prices in the efficient market (Fama, 1970). The Arbitrage Pricing Theory (APT) is the multivariate regression model in which the stock return is a linear function of diverse macroeconomic factors, and the sensitivity of each macro factor was apprehended by the beta-coefficients (Ross, 1976). Macroeconomic variables like IIP, inflation, yield-spread amongst the lengthy and small duration government bonds, expressively described the stock returns (Chen et al., 1986). Many researches show the impact of macro-economic factors using APT model (Chen et al., 1986; Hamao, 1988; Martinez & Rubio, 1989; Schwert, 1990; Poon &Taylor, 1991; Ferson & Harvery, 1991). On the other hand, the Capital Asset Pricing Model (CAPM) is a balanced model that describes the reason for diverse expected returns for diverse securities. It offers a method for measuring risk and decoding that risk into approximations of expected equity returns. CAPM states that expected returns differ as securities have diverse betas. This model is based on measuring the systematic risk, that is, market risk (Beta) and market risk take into consideration all the macro economic factors. Therefore, many extensions of CAPM (Chaudhary et al., 2020) are used, and for the extended CAPM, the use of a correct market proxy is very essential. The real market portfolio is not evident, so predictable proxies are used to mimic the value of a universe of assets (Roll, 1977). The configuration of the market portfolio proxy affects the intended expected returns so it rests as a challenge to discover the correct market portfolio to capture the market risk by the CAPM (Brown & Brown, 1987; Stambaugh, 1982; Kamara & Young, 2018).

Multi-asset class market proxy suffers from data availability (Doeswijk et al., 2014). Fama and French (1992, 1993) used a value-weighted portfolio consisting of completely common stocks available on the Newyork Stock Exchange (NYSE), American Stock Exchange (AMEX), and National Association of Securities Dealers Automated Quotations (NASDAQ). Compared to single-index proxies, this method enables a more granular representation of the market portfolio because all listed common shares at the NYSE, AMEX, and NASDAQ are considered instead of only the largest ones. In country like India, there is no a multi-asset portfolio, and BSE30, BSE100, BSE200, BSE500, Nifty50, Nifty200, Nifty500 have been taken as proxies for the market. But be it value weighted portfolio or multi-asset portfolio, the question remains which is the best proxy for the market. Further research is needed to make a final evaluation of the applicability of macro-economic models to proxy the market mainly in volatile emerging markets. No such study is conducted for most emerging markets such as India. The aim of this study is to examine if fluctuations in macroeconomic factors in India elucidate the overall stock values, and if so, which index captures it best.

2. METHODOLOGY

2.1. Selection of variables

Of the many macroeconomic variables, this study includes four variables that are selected based on academic relevance, performance methods of the economy, and their applications and outcomes in most of the empirical works. The level of actual economic movement is taken as a critical factor in defining stock market returns.

2.2. Industrial production (IIP)

The historical way of measuring economic performance is through gross domestic product (GDP) or gross national product (GNP), but since GDP or GNP data are not easily available, the IIP is widely used to integrate real output. The IIP is pro-cyclical, that is, it increases during economic growth and decreases in the event of a recession (Tainer, 1993; Maysami et al., 2004); there is a clarification for higher return variation (Ratanapakorn & Sharma, 2007) indicating a positive correlation between IIP and stock performance (Chen et al., 1986; Maysami et al., 2004; Rahman et al., 2009; Foerster et al., 2011). IIP thus acts as a proxy for the actual economic activity (Fama, 1990; Geske & Roll, 1983).

2.3. Inflation

Inflation is another variable extensively used in the literature. There is a mixed empirical influence of inflation on stock price. On the basis of Fama's proxy effect (Fama, 1981) dividend discount model, there is a negative relationship between inflation and stock performance (Nelson, 1976; Fama & Schwert, 1977; Chen et al., 1986; Mukherjee & Naka, 1995; Pal & Mittal, 2011). As the stock price is the present value of expected future dividends, a rise in inflation could increase the risk free rate resulting in a decrease in the stock price. There are also studies that show a positive relationship between inflation and stock returns, indicating that equity acts as a hedging mechanism in contradicting inflation (Ratanapakorn & Sharma, 2007).

2.4. Money supply

Another essential macro-economic variable, money supply, is highly referred in the literature for determining the stock price and again causes controversy. If money supply is the result of the economic impetus, then the subsequent company earnings will rise the stock prices (Mukherjee & Naka, 1995; Maysami et al., 2004; Ratanapakorn & Sharma, 2007); when the increased money supply results in an increase in inflation, then it raises the discount rate and hence reduces the stock price (Rahman et al., 2009).

2.5. Exchange rate

Apart from IIP, inflation and money supply, another variable such as the exchange rate is also a highly used macroeconomic factor in determining stock returns. The influence of the exchange

http://dx.doi.org/10.21511/imfi.18(3).2021.02

rate on the equity price depends on the prominence of a country's international trade and the balance of trade. The decline in value of a home currency with reference to a foreign currency influences an investor to modify funds from national stocks to overseas currency assets, thus decreasing the stock price in the domestic country, and vice versa. Rise in the national currency reduces the value of exporting firms, thus negatively affecting stock prices, and vice versa (Mukherjee & Naka 1995).

3. DATA

This study is based on time series data taken from three sources, such as the website of the Bombay Stock Exchange (BSE), National Stock Exchange (NSE), and Reserve Bank of India (RBI). For this study, five broad indices, namely, BSE100, BSE200, BSE500, BSE Sensex and Nifty50, have been taken to be as market proxies for the Indian stock market. As it is not possible to include all the possible characteristics describing the stock market performance, four major macroeconomic variables such as industrial production index (IIP), consumer price index (CPI), money supply and exchange rate are taken for this study. The choice of macroeconomic variables in this study is taken to include the major macroeconomic activities, and it is supported by the prevailing literature and empirical facts. IIP is taken as a proxy for the actual yield, CPI is used to consider the inflation in the economy, narrow money denoted by M1, and the rupee vs dollar exchange rate denoted by EXR. To achieve the objective of the study, month-wise data from January 2013 to December 2019 are taken consisting of 84 data facts for the investigation. The selection of the study period is such that it includes the normal phase of the Indian stock market and takes into account the current base year of macroeconomic variables under consideration. Equity indices may not mirror the economy in the crisis period due to variety of reasons, therefore the data is taken up till December, 2019, and the current COVID-19 period is ignored. Explanations of variables along with the data sources are shown in Table 1 after converting the variables into natural logarithmic form.

Table 1. Description of variables

Acronym	Description	Data source
BSE100	Is intended to evaluate the result of the top 100 biggest and utmost liquid Indian companies	BSE
BSE200	Is intended to evaluate the result of the top 200 BSE listed companies on the basis of size and liquidity	BSE
BSE500	Is intended to evaluate a broad representation of the top 500 BSE listed companies covering all major sectors	BSE
BSE SENSEX	Is the BSE index representing 30 largest and well-capitalized stocks	BSE
NIFTY50	Is the index comprising of 50 largest and most well-capitalized stocks listed on NSE	NSE
IIP	Is an index covering the growth of various sectors in the Indian economy with the base year as 20112012–	RBI
CPI	Is an index to evaluate the change in price of a basket of goods mainly purchased by a consumer or household over time. The current base year is 2012=100	RBI
M1	Is a narrow method of the money supply, which includes physical currency, demand deposits, traveler's checks, and other checkable deposits	RBI
EXR	US Dollar conversion rate for Indian Rupee on the monthly average	RBI

3.1. Statistical methods for data analysis

To obtain a suitable market proxy for the capital asset pricing model and its extension, in the context of the Indian stock market, firstly, a stationarity test of all the time-series data is used by means of the Augmented Dickey Fuller (ADF) methodology. Secondly, the optimal lag length to be used for the cointegration model was determined by the Unrestricted Vector Auto Regression model. Thirdly, the cointegration technique by Johansen was used to determine cointegration in variables. To find the cointegrating relationship, a Vector Error Correction Model (VECM) was used to find the short-run and long-run dynamics of the variables. The choice of a qualitative method is assumed, taking into account the data characteristics and available literature (Mukherjee & Naka, 1995; Nasseh & Strauss, 2000; Greene, 2012).

3.2. Unit root test

Trending behavior is generally seen in the case of financial and economic variables because the series are nonstationary. Accordingly, the use of non-stationary time series for a regression framework could result in unauthentic regression, useless economics, and statistical implication. An Augmented Dickey-Fuller (ADF) testing procedure is used to test for stationarity. The null hypothesis under the ADF test states that a unit root is present, and the alternative is stationary. The following testing equation (with intercept) is estimated to implement the ADF test:

$$\Delta z_t = \alpha_0 + \theta z_{t-1} + \alpha_1 \Delta z_{t-1} + \\ + \alpha_2 \Delta z_{t-2} + \ldots + \alpha_p \Delta z_{t-p} + a_t. \quad (1)$$

The choice of lag-lengths (p) is decided based on the Schwarz Bayesian criterion (SBC).

3.3. Johansen cointegration

The Johansen test is used in this study to determine cointegration. The p order equation given by Johansen (1995) is as follows:

$$y_t = \mu_0 + \mathrm{A}_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t, \quad (2)$$

where y_t is an $n \times 1$ vector of integrated variables of order one, commonly denoted I (1), and ε_t is an $n \times 1$ vector of innovation. This VAR can be again written as:

$$\Delta y_t = \mu + \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t, \quad (3)$$

where

$$\prod = \sum_{i=1}^{p} \mathrm{A}_i - \mathrm{I} \text{ and } \Gamma_i = -\sum_{j=i+1}^{p} \mathrm{A}_j. \quad (4)$$

Both forms of techniques of cointegration, the trace test and maximum eigenvalue test hold a null hypothesis that there are no cointegrating equations.

3.4. Vector error correction model

When the series are cointegrated and are stationary in their difference form, then the vector error correction (VEC) model, an unusual circumstance of the VAR framework, can be used. The multivariate VECM can be specified as:

$$\Delta Index_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i} \Delta Index_{t-i} + \\ + \sum_{i=1}^{p} \beta_{2i} \Delta \mathrm{IIP}_{t-i} + \sum_{i=1}^{p} \beta_{3i} \Delta \mathrm{CPI}_{t-i} + \\ + \sum_{i=1}^{p} \beta_{4i} \Delta \mathrm{M1}_{t-i} + \sum_{i=1}^{p} \beta_{5i} \Delta \mathrm{EXR}_{t-i} + \lambda_1 z_{t-1} + \varepsilon_t. \quad (5)$$

In this equation, the composite index is an attribute of its own lag and the lag of all other macroeconomic variables in this study.

4. FINDINGS AND DISCUSSIONS

The descriptive statistics for all the five indices, namely, S&P BSE 500 (BSE500), BSE Sensitive Index (BSESensex), S&P BSE 200 (BSE200), S&P BSE 100 (BSE100), Nifty 50 (NIFTY50), and the four macroeconomic factors such as Industrial Production Index (IIP), Consumer Price Index (CPI), narrow money supply (M1) and the exchange rate (EXR), are presented in Table 2. The high standard deviation for BSE500 indicates that it is comparatively more volatile with respect to other stock indices, and M1 is more volatile as compared to other macroeconomic variables.

The stationarity of the data series is recognized by using the standard unit root test, namely the Augmented Dickey-Fuller (ADF) test. The find-

Table 2. Descriptive statistics of Indian stock indices and macroeconomic variables (natural log form): 2013–2019

Particulars	Stock indices					Macroeconomic variables			
	BSE 100	BSE 200	BSE 500	BSE SENSEX	NIFTY 50	M1	IIP	EXR	CPI
Mean	9.0791	8.1942	9.3348	10.2568	9.0620	17.057	4.775	4.170	4.847
Maximum	9.4122	8.5328	9.6707	10.6275	9.4066	17.432	4.970	4.298	5.013
Minimum	8.6028	7.6815	8.8060	9.8320	8.6074	16.709	4.618	3.986	4.650
Std. Dev.	0.2319	0.2469	0.2523	0.2215	0.2238	0.211	0.082	0.068	0.091
Observations	84	84	84	84	84	84	84	84	84

http://dx.doi.org/10.21511/imfi.18(3).2021.02

Table 3. ADF unit root test for variables for 2013–2019

Indices	Level	First difference
	T-Statistics	*T*-Statistics
BSE_100	–0.910608	–8.964740*
BSE_200	–0.929991	–8.789570*
BSE_500	–0.991489	–8.649664*
BSE_SENSEX	–0.716083	–9.289370*
Nifty50	–0.844885	–9.184359*
Macroeconomic variables		
M1	–0.902402	–7.864895*
IIP	–1.366719	–3.490423**
EXR	–2.530962	–10.55153*
CPI	–0.994784	–5.151075*

Note: * significant at the 1% level; ** significant at the 5% level.

ings are shown in Table 3. All the variables are non-stationary in the level form with the intercept, since they have lower test statistic than critical value and hence null hypothesis cannot be rejected. Alternatively, as shown in Table 3, almost all of the variables in differenced form possess high test statistic compared to critical value, supporting to reject the null hypothesis with a conclusion about the stationarity of the variables in differenced form at a 1 and 5 percent level. Thus, all the variables used in this paper are integrated in order of 1, indicating that the variables possess an infinite variance that increases over time, shocks are long lasting, and autocorrelation tends to be one, so cointegration testing can be done.

It is worth noting that the lag order in the time series examination is relatively sensitive to the outcomes, so selecting the lag length is an important criterion. Selecting the number of lags is a subjective phenomenon and depends on multiple factors such as setting of the study, experimental proof, and hypothesis. Opting for excessive lags can lead to losing observations and error in forecasts, and too few lags can result in residual autocorrelation (Stock & Watson, 2001). This study has tested for lag lengths, and lag order 1 has been selected as an optimum lag on the basis of the Schwarz Information Criterion (SIC) between 1 and 8. The Johansen Cointegration test is employed to see if there is any long-term association between re-

Table 4. Cointegration test for stock indices and macroeconomic variables for 2013–2019

Indices	No. of cointegrating relationships (*r*)	Trace statistics	0.05 critical value	*P*-values	Max statistics	0.05 critical value	*P*-values
BSE_100	*r*=0	72.88437	69.81889	0.0279	33.99182	33.87687	0.0485
	r=1	38.89255**	47.85613	0.2646	21.41161**	27.58434	0.2521
	r=2	17.48094	29.79707	0.6045	10.40402	21.13162	0.7061
BSE_200	*r*=0	74.52238	69.81889	0.0200	34.35151	33.87687	0.0439
	r=1	40.17087**	47.85613	0.2165	22.47743**	27.58434	0.1969
	r=2	17.69345	29.79707	0.5888	10.93117	21.13162	0.6542
BSE_500	*r*=0	75.90169	69.81889	0.0151	34.43040	33.87687	0.0429
	r=1	41.47129**	47.85613	0.1741	23.64544**	27.58434	0.1476
	r=2	17.82585	29.79707	0.5790	11.48419	21.13162	0.5990
BSE_SENSEX	*r*=0	71.03384	69.81889	0.0399	34.82718	33.87687	0.0384
	r=1	36.20665**	47.85613	0.3860	20.63059**	27.58434	0.2992
	r=2	15.57607	29.79707	0.7417	8.517420	21.13162	0.8693
NIFTY50	*r*=0	71.92717	69.81889	0.0336	34.25002	33.87687	0.0451
	r=1	37.67715**	47.85613	0.3163	20.71585**	27.58434	0.2938
	r=2	16.96130	29.79707	0.6429	9.342256	21.13162	0.8039

Note: ** significant at the 5% level.

spective composite stock indices and all macroeconomic variables. The results of the Johansen Cointegration test are shown in Table 4.

Both the test, the trace and maximum eigenvalue in Table 4 show that there is a single cointegrating vector between the indices and the macro-economic variables, demonstrating evidence of a long-term relationship between stock indices and all the four macroeconomic variables. The proof of a cointegrating relationship shows that there is a common force that carries variables together in the long term, and the relation is non fabricated.

Table 5 shows that the equilibrium long-run relationship between industrial production and the BSE-500 is positive and statistically significant, whereas with all other composite indices, as mentioned in the table, the relationship is negative and significant. Like many literature sources, this study is based on the industrial production index as a dummy for real economic performance and discovers a vague relationship for the Indian indices. A positive relation between stock price and real output is consistent with Maysami et al. (2004), Ratanapakorn and Sharma (2007), Rahman et al. (2009), and Akbar et al. (2012), who found similar results for Singapore, US, Malaysia, and Pakistan, respectively. The positive relationship shows that with the existence of cointegration, there is an increase in the industrial production index, resulting in a rise in the company earning, which improves the present worth of the organization and hence increases the stock price. Though, Young (2006) claims that a positive relationship between IIP and stock market returns is not the same when more recent US data is used. Similar findings are shown by Bhuiyan and Chowdhury (2019) for the USA. To dwell on, from a sector composition standpoint, the sectors currently at the top of the market-cap ranking are Finance and Technology. Therefore, the BSESENSEX, NIFTY, and BSE100 are highly concentrated with Finance and Technology. Though finance/banking and tech stocks are traditionally the major sectors in emerging market indices, having a nearly more than 50% weightage is unusual even for an emerging market. The dominance of this sector can be one of the reasons not to hold a positive relationship with all composite indices, leaving behind BSE-500, which is somewhere a broader representation of economy.

The inverse relationship between stock price and inflation is in support of the proxy effect of Fama (1981), which clarifies that an increase in inflation raises the cost of production; this unfavorably affects the profit along with the level of real economic performance, since the real performance is directly linked with stock performance, so with the rise in inflation, the stock price falls. Pal and Mittal (2011) and Akbar (2012) obtained an inverse relationship for India and Pakistan, though this is contradictory to Maysami et al. (2004) and Ratanapakorn and Sharma (2007), who examine a direct relationship between inflation and stock performance, concluding that equity acts as a hedge against inflation. In this study, the BSE500 index is negatively related with the CPI (proxy of inflation), whereas all other composite indices show a positive relationship with CPI.

The direct relationship of stock indices with money supply is supported by Abdullah and Hayworth (1993), Mukherjee and Naka (1995), Ratanapakorn and Sharma (2007) and Humpe and Macmillan (2009), and contradicts with Dhakal et al. (1993). There are two potential ways through which the direct relation can be explained. Mukherjee and Naka suggest that a rise in money supply can be an incentive for economic growth, which can raise future cash flows. Ratanapakorn and Sharma argue that a rise in money supply decreases interest rates because of increased liquidity resulting in portfolio rebalancing into more financial assets. Whereas Dhakal et al. (1993) emphasize that a rise in money supply can result in an unexpected rise in inflation and uncertainty, which may inversely affect stock prices. In this study, the BSE_500 index is negatively related with money supply, whereas all other composite indices show a positive relationship with money supply.

The relationship with the exchange rate and BSE500 is found positive, whereas it is negative with all other composite indices.

Knowing that all composite indices have singular cointegrating relationship with all macroeconomic variables, the VECM is applied. The error correction term in the VECM framework depicts the long-run equilibrium relationship between the stock index and the macroeconomic variables. It denotes the speed of adjustment by which the dependent variable returns to equilibrium

http://dx.doi.org/10.21511/imfi.18(3).2021.02

Table 5. Long-term equations

Indices	M1	IIP	EXR	CPI	Constant
BSE-100	5.933089*	–22.89522*	–9.605115**	12.43179**	–3.010449
	(1.65238)	(4.05499)	(3.72467)	(5.08766)	
BSE-200	23.08794*	–96.58405*	–35.85555**	46.01485**	2.013731
	(6.84045)	(16.7980)	(15.4200)	(21.0650)	
BSE-500	–20.67929*	88.65158*	29.51814**	–36.15862***	–9.042007
	(6.22876)	(15.2962)	(14.0372)	(19.1762)	
BSE-SENSEX	2.783827*	–8.838787*	–4.276466*	5.446274**	–3.591268
	(0.64271)	(1.57863)	(1.44676)	(1.98065)	
NIFTY50	3.540760*	–12.60999*	–5.809740*	7.566997**	–3.576455
	(0.91596)	(2.24905)	(2.06403)	(2.82220)	

Note: Figures in ( ) indicate the value of Standard error, * significant at 1% level; ** significant at 5% level.

Table 6. Error correction model

Variables	BSE_100	BSE_200	BSE_500	BSE_ Sensex	Nifty50
	Δ Index	Δ Index	Δ Index	Δ Index	Δ Index
ECT	0.010963	0.002643***	–0.003063***	0.020727	0.016717
	(0.00628)	(0.00152)	(0.00170)	(0.01523)	(0.01108)
$\Delta Index_{t1-}$	0.047596	0.063446	0.069920	0.033771	0.040098
	(0.11692)	(0.11608)	(0.11582)	(0.11838)	(0.11792)
ΔIIP_{t1-}	–0.264321**	–0.267765**	–0.274692**	–0.235631**	–0.248945**
	(0.10044)	(0.10173)	(0.10460)	(0.09559)	(0.09841)
$\Delta M1_{t1-}$	0.221029**	0.229553**	0.236321**	0.204674**	0.217406**
	(0.09642)	(0.09742)	(0.10009)	(0.09203)	(0.09455)
ΔCPI_{t1-}	0.395434	0.401674	0.490818	0.143662	0.175683
	(0.81964)	(0.81555)	(0.82924)	(0.79943)	(0.81242)
ΔEX_{t-1}	0.327600	0.310575	0.274605	0.384781	0.370184
	(0.23696)	(0.23721)	(0.24184)	(0.22804)	(0.23474)
Adj *R*-Square	0.075198	0.077857	0.075863	0.069371	0.073005
F-Statistics	2.097723	2.139806	2.108222	2.006316	2.063189
Prob (*F*-Statistics)	0.063347	0.058487	0.062099	0.075276	0.067623
Durbin Watson Statistics	1.933274	1.916964	1.915557	1.959356	1.940369
Chi-Sq. SC (Breusch-Godfrey Serial Correlation LM Test)	0.4786	0.3748	0.3689	0.6662	0.5198
Residuals (JB Test)	0.3358	0.8391	1.5136	0.6651	0.4048
Chi-Sq. Het(1)	0.8049	0.8564	0.8812	0.8310	0.8474

Note: Figures in ( ) indicate the standard error value, * significant at the 1% level; ** significant at the 5% level; *** significant at the 10% level.

after deviation. Furthermore, the coefficient of the lagged regressor tell about the short-run relationship.

Table 6 shows the error correction models for all the composite indices. The error correction term needs to be negative (between 0 and –1) and significant to retain its economic interpretation. The positive coefficient is not a good sign for the model as it implies that the process is not converging in the long run. The coefficients of the error correction terms are significant for the S&P BSE 500 and S&P BSE 200, but the S&P BSE 500 coefficient is negative, and the S&P BSE 200 coefficient comes out to be positive. The coefficient of an error correction term in the case of S&P BSE 500 shows that equilibrium is restored by about 0.31% each month. However, the restoration to equilibrium path in the case of any disturbance in the system will take a longer time as the value ECT is quite small (–0.0031). Along with this, the diagnostics of all the equations of the error correction model that test the presence of serial correlation, normality of the residuals and heteroskedasticity tend to indicate that the equations are well-specified. Besides this, the stability of the coefficients by the CUSUM test has been tested. The tests indicate no structural break in the period and the models are set to be dynamically stable.

The BSE-500 is a better choice as a market portfolio proxy in the normal phase of the economy.

CONCLUSION

Economic indicators are often used to predict future economic activity, financial market performance, and exchange rates. Macroeconomic data are used by investment professionals to predict the earnings potential of companies and to find which asset classes can be more attractive. But at the same time, it cannot be denied that the gap between the economy and the stock market widened in the crisis period. Recently, during the COVID era, equity indices have failed to reflect the economy, and the debate about the stock market-economy gap has generated more heat than light. This brings us back to the question of whether the index really reflects the ground reality, and its quantification is an empirical question. In addition, this question is pertinent because the choice of a market portfolio proxy is very important in a capital asset pricing model.

The study of asset pricing for the emerging market of India has been done by taking mostly either BSE-Sensex, Nifty-50, or BSE-500 as a market portfolio proxy. Market portfolio composition substantially affects the cost of equity. The objective of this study is to provide a market portfolio proxy for the Indian equity market. BSE 500 can be considered a better composition as it represents large, mid and small companies in a single index.

This paper shows a noteworthy relationship between stock market returns and IIP, CPI, money supply, and exchange rate and, at the same time it is assumed that the BSE-500 is a better choice as a market portfolio proxy in the normal phase of the economy, as this index shows a significant relationship with macroeconomic variables, and the deviation of the index from the long-term equilibrium is amended, though it takes more time. The results of this study can outspread the prevailing literature by bringing some insight to policymakers and practitioners in selecting the right proxy market portfolio to reflect macroeconomic factors.

AUTHOR CONTRIBUTIONS

Conceptualization: Rashmi Chaudhary, Priti Bakhshi.
Data curation: Rashmi Chaudhary.
Formal analysis: Rashmi Chaudhary, Priti Bakhshi.
Investigation: Rashmi Chaudhary, Priti Bakhshi.
Methodology: Rashmi Chaudhary, Priti Bakhshi.
Project administration: Rashmi Chaudhary, Priti Bakhshi.
Resources: Rashmi Chaudhary, Priti Bakhshi.
Software: Rashmi Chaudhary.
Supervision: Rashmi Chaudhary, Priti Bakhshi.
Validation: Rashmi Chaudhary, Priti Bakhshi.
Visualization: Rashmi Chaudhary, Priti Bakhshi.
Writing – original draft: Rashmi Chaudhary, Priti Bakhshi.
Writing – review & editing: Rashmi Chaudhary, Priti Bakhshi.

REFERENCES

1. Abugri, B. A. (2008). Empirical relationship between macroeconomic volatility and stock returns: Evidence from Latin American markets. *International Review of Financial Analysis, 17*(2), 396-410. https://doi.org/10.1016/j.irfa.2006.09.002
2. Asness, C., Frazzini, A., Israel, R., Moskowitz, T. J., & Pedersen, L. H. (2018). Size matters, if you control your junk. *Journal of Financial Economics, 129*(3), 479-509. https://doi.org/10.1016/j.jfineco.2018.05.006
3. Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics, 9*(1), 3-18. https://doi.org/10.1016/0304-405X(81)90018-0

http://dx.doi.org/10.21511/imfi.18(3).2021.02

4. Brown, K. C., & Brown, G. D. (1987). Does the composition of the market portfolio really matter? *Journal of Portfolio Management, 13*(2), 26-32. https://doi.org/10.3905/jpm.1987.26

5. Bruner, R. F., Li, W., Kritzman, M., Myrgren, S., & Page, S. (2008). Market integration in developed and emerging markets: Evidence from the CAPM. *Emerging Markets Review, 9*(2), 89-103. https://doi.org/10.1016/j.ememar.2008.02.002

6. Cakici, N. (2015). *The five-factor Fama-French model*: *International evidence*. Available at SSRN 2601662.

7. Chaudhary, R., Bakhshi, P., & Gupta, H. (2020). Volatility in International Stock Markets: An Empirical Study during COVID-19. *Journal of Risk and Financial Management, 13*(9), 208. https://doi.org/10.3390/jrfm13090208

8. Chen, N. F., Roll, R., & Ross, S. A. (1986). Economic forces and the stock market. *Journal of Business*, 383-403. https://www.jstor.org/stable/2352710

9. Doeswijk, R., Lam, T., & Swinkels, L. (2014). The global multi-asset market portfolio, 1959–2012. *Financial Analysts Journal, 70*(2), 26-41. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2352932

10. Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance, 25*(2), 383-417. https://doi.org/10.7208/9780226426983-007

11. Fama, E. F. (1981). Stock returns, real activity, inflation, and money. *The American Economic Review, 71*(4), 545-565. https://www.jstor.org/stable/1806180

12. Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance, 47*(2), 427-465. https://doi.org/10.7208/9780226426983-017

13. Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*(1), 3-56. Retrieved from https://rady.ucsd.edu/faculty/directory/valkanov/pub/classes/mfe/docs/fama_french_jfe_1993.pdf

14. Fama, E. F., & French, K. R. (2012). Size, value, and momentum in international stock returns. *Journal of Financial Economics, 105*(3), 457-472. https://doi.org/10.1016/j.jfineco.2012.05.011

15. Ferson, W. E., & Harvey, C. R. (1991). Sources of predictability in portfolio returns. *Financial Analysts Journal, 47*(3), 49-56. https://doi.org/10.2469/faj.v47.n3.49

16. Foerster, A. T., Sarte, P. D. G., & Watson, M. W. (2011). Sectoral versus aggregate shocks: A structural factor analysis of industrial production. *Journal of Political Economy, 119*(1), 1-38. Retrieved from https://www.journals.uchicago.edu/doi/abs/10.1086/659311

17. Geske, R., & Roll, R. (1983). The fiscal and monetary linkage between stock returns and inflation. *The Journal of Finance, 38*(1), 1-33. https://doi.org/10.2307/2327635

18. Griffin, J. M. (2002). Are the Fama and French factors global or country specific? *The Review of Financial Studies, 15*(3), 783-803. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=262647

19. Hamao, Y. (1988). An empirical examination of the arbitrage pricing theory: Using Japanese data. *Japan and the World Economy, 1*(1), 45-61. https://doi.org/10.1016/0922-1425(88)90005-9

20. Ibrahim, M. H., & Aziz, H. (2003). Macroeconomic variables and the Malaysian equity market. *Journal of Economic Studies*. https://doi.org/10.1108/01443580310455241

21. Kamara, A., & Young, L. (2018). Yes, the Composition of the Market Portfolio Matters: The Estimated Cost of Equity. *Financial Management, 47*(4), 911-929. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3091287

22. Martinez, M. A., & Rubio, G. (1989). *Arbitrage pricing with macroeconomic variables: an empirical investigation using Spanish data*. Working Chapter, Universidad del Pais Vasco.

23. Maysami, R. C., Howe, L. C., & Rahmat, M. A. (2005). Relationship between macroeconomic variables and stock market indices: Cointegration evidence from stock exchange of Singapore's All-S sector indices. *Jurnal Pengurusan* (*UKM Journal of Management*), 24. Retrieved from https://core.ac.uk/download/pdf/11490872.pdf

24. Maysami, R. C., Loo, S. W., & Koh, T. K. (2004). Co-movement among sectoral stock market indices and cointegration among dually listed companies. *Jurnal Pengurusan, 23,* 33-52. Retrieved from https://ejournal.ukm.my/pengurusan/article/view/1245

25. Mukherjee, T. K., & Naka, A. (1995). Dynamic relations between macroeconomic variables and the Japanese stock market: an application of a vector error correction model. *Journal of Financial Research, 18*(2), 223-237. https://doi.org/10.1111/j.1475-6803.1995.tb00563.x

26. Nelson, C. R. (1976). Inflation and asset prices in a monetary economy. *Journal of Finance, 31,* 471-483. https://doi.org/10.1016/S0165-1765(97)82137-4

27. Pal, K., & Mittal, R. (2011). Impact of macroeconomic indicators on Indian capital markets. *The Journal of Risk Finance*. https://doi.org/10.1108/15265941111112811

28. Poon, S., & Taylor, S. J. (1991). Macroeconomic factors and the UK stock market. *Journal of Business Finance & Accounting, 18*(5), 619-636. https://doi.org/10.1111/j.1468-5957.1991.tb00229.x

29. Rahman, M. M., & Salahuddin, M. (2009, September). The determinants of economic growth in Pakistan: does stock market development play a major role?. In *Proceedings of the 38th Australian Conference of*

Economists (*ACE 2009*) (pp. 1-22). Economic Society of Australia (South Australian Branch). http://eprints.usq.edu.au/id/eprint/5793

30. Ratanapakorn, O., & Sharma, S. C. (2007). Dynamic analysis between the US stock returns and the macroeconomic variables. *Applied Financial Economics, 17*(5), 369-377. https://doi.org/10.1080/09603100600638944
31. Reinganum, M. R. (1981). Misspecification of capital asset pricing: Empirical anomalies based on earnings' yields and market values. *Journal of financial Economics, 9*(1), 19-46. https://doi.org/10.1016/0304-405X(81)90019-2
32. Roll, R. (1977). A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory. *Journal of Financial Economics, 4*(2), 129-176. https://doi.org/10.1016/0304-405X(77)90009-5
33. Rosenberg, B. (1981). The capital asset pricing model and the market model. *The Journal of Portfolio Management, 7*(2), 5-16. Retrieved from https://jpm.pm-research.com/content/7/2/5
34. Ross, S. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory, 13*(3), 341-360. https://doi.org/10.1016/0022-0531(76)90046-6
35. Schwert, G. W. (1990). Stock returns and real activity: A century of evidence. *The Journal of Finance, 45*(4), 1237-1257. https://doi.org/10.2307/2328722
36. Stambaugh, R. F. (1982). On the exclusion of assets from tests of the two-parameter model: A sensitivity analysis. *Journal of Financial Economics, 10*(3), 237-268. https://doi.org/10.1016/0304-405X(82)90002-2
37. Tainer, E. M. (1993). *Using economic indicators to improve investment analysis*. Wiley.
38. Varamini, H., & Kalash, S. (2008). Testing market efficiency for different market capitalization funds. *American Journal of Business*. Retrieved from https://www.researchgate.net/publication/46511082_Testing_Market_Efficiency_for_Different_Market_Capitalization_Funds

http://dx.doi.org/10.21511/imfi.18(3).2021.02