

# **Geographical correlation of Market Returns**

## **-a test for citation score metric**



**Bachelor's Thesis Project Report**

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## **Abstract**

In recent years there has been an interlinking of various field to develop asset pricing models that can efficiently explain the variation in returns of assets. One of the factors influencing the returns of various companies is their location diversity.

There is strong evidence for country level geographical co-movement of equity returns, as Risk free market return explains a large portion of an equity return. In this paper we go to a deeper segregation and look, whether there is any state level geographical co-movement between company returns.

We test the co-movement of headquarters portfolio and ER Portfolio (Consisting of companies for which a state is economically relevant).

No. of citations of a state in the Annual Report of a firm is taken as a metric to determine economic relevance of state for the firm. If there is a strong link between returns of these portfolios then, we can conclude that citation score can act as robust metric for availability of local value-relevant information. And incorporating multi-dimensional nature of firm locations can allow for a more comprehensive examination of geography based co-movements.

A similar test for US listed equities by Prof. Alok Kumar of the University of Miami, concludes that there is a co-movement among returns of securities of firms headquartered in one state or having a high degree of economic activity in the state and citation score is a robust metric to determine availability of value relevant local information

In our analysis, we observe that there is no indication of co-movement of returns of these two portfolios. The regression done for all possible states, reject the hypothesis of co-movement. Hence, the paper concludes that in Indian context, citation score doesn't act as a robust metric for availability of local value-relevant information, or there is no advantage of local information availability

## **Introduction**

The economic interests of the typical public firm are geographically dispersed. A firm's corporate headquarters may be in one state while its plants and operations are located in other states, often far away from the headquarters. Similarly, customers and suppliers, R&D facilities, and other firm activities need not be concentrated around the headquarters. When the economic interests of a firm are geographically dispersed, value-relevant information about the firm is also likely to be spatially distributed.

We try to look for a metric to account for the volume of local value relevant information available at various operational centres for a firm.

A research by Prof. Alok Kumar at the University of Miami, concludes that citation score of a state in annual K-10 filing of a company acts as a robust measure for availability of value relevant local information. It also concludes that incorporating Economically relevant state based metrics can provide better results than using only Headquarter state metrics

In this paper, we examine whether the spatial distribution of information about publicly traded Indian firms affects returns of the firms. We examine whether there is a co-movement between the returns of portfolios of firms headquartered in a state and firms for which the state is economically relevant.

The primary aim is to search for a metric that can reflect local information availability. We tested whether citation score of a state in the annual report of a firm can act as a robust metric for determining local information availability.

If an institutional investor is in the vicinity of economically relevant regions for a firm, it may have an information advantage over other investors. The information flow may be originating due to local media or it may even point to insider trading. Local social networks could be another important channel through which information about firms may reach local investors.

The strong dependence of security returns on market returns recognises the nation based geographical co-movement.

A research on US public companies, by Prof. Alok Kumar of the University of Miami shows that recognizing the multi-dimensional nature of firm location allows for a more comprehensive examination of geography-based co-movement. It also shows that citation score of US states in annual K-10 filings of US public firms acts as a robust measure of local information availability.

But there is no such study for Indian public firms. This paper uses similar methodology to look at geography based co-movements for Indian public firms, and availability of value relevant local information.

We make annual report citation based measure for each state called *citation score*. This citation score is used as a measure of economic relevance of a state for the company.

Using this data and headquarter location data we make 2 portfolios for each state, namely HQ Portfolio and ER Portfolio. An OLS based regression gives us prediction model for each of these variables, which can tell us the level of co-movement between the returns of these portfolios of a state.

The set of companies used for the analysis purpose is BSE50. The headquarters of all the firms in the set lie within 7 states namely Delhi, Maharashtra, West Bengal, Rajasthan, Tamil Nadu, Karnataka, Gujarat. Hence we make prediction models for 7 states.

## **Objective**

The research aims to study using regression models, the dependence of state headquarters portfolio returns on various market factors and state economically relevant portfolio returns and vice-e-versa.

Here state headquarters portfolio consists of firms having headquarters in a particular state, while state economically relevant portfolio consists of companies having the state as an economically relevant region for various periods of time.

If there is a strong link between returns of these portfolios then, we can say that citation score acts as a robust measure for determining volume of value relevant local information, and we can see whether incorporating multi-dimensional nature of firm locations can allow for a more comprehensive examination of geography based co-movements.

## **Sources of Data used**

The implementation of our hypothesis requires a set of firms, a dataset of economically relevant states for each firm, headquarter location of each firm, and the returns of each firm.

The analysis have been performed on the set of BSE50 companies, we use monthly returns of firms for our analysis.

A list of BSE50 constituent companies is taken from BSE website on 1st February 2019. Monthly return data for these firms is calculated from monthly closing price data, i.e. closing price data of firm's security on last trading day of every month.

The data for headquarter state of each firm is obtained from ProwessIQ repository

While, economically relevant states are determined based on their citation score in company's annual report, which is obtained from BSE website.

The analysis is performed for a period of 5 years i.e from January 2014 to December 2018, hence all the required data is obtained for these 5 years.

Overall, for each firm we have 60 data points corresponding to monthly returns, which are used to perform OLS regression

## Methodology

The monthly return of a security is calculated using monthly closing prices(closing price on last trading day of each month) of a security, using this formula

$$\text{Return}(t) = \frac{\text{Closing Price}(t) - \text{Closing Price}(t-1)}{\text{Closing Price}(t-1)} * 100$$

Where Return( $t$ ) is the monthly return of any month  $t$ , Closing Price( $t$ ) is the closing price of any month  $t$ (closing price on last trading day of the month).

Such return is calculated for every security for 5 years.

After calculating this return,  $R_f$  (Risk free return) is subtracted from it to get a risk free return of security

We make headquarters portfolio of each state, this portfolio consists of companies having headquarters in the state.

We also make an ER portfolio for each state, which consists of companies for which the state is an economically relevant state in a year.

Then OLS regression is performed for each state, with HQ portfolio return as dependent variable and ER portfolio return as independent variable and vice-e-versa.

### Making of ER Portfolio

An important part of the analysis is determination of economically relevant states for a firm in any particular year and determination of monthly returns for a security.

The economic relevance of a state for a firm in any year is based on the no. of citations of the state in Annual Report of the firm for that year.

No. of citations of a state in annual report of a firm is called as citation score of the state for that firm in that particular year. Hence for each company citation score of all the states is determined for any particular year.

From the citation score list, the headquarter state is removed. From this new list of citation scores, three states having most citation scores are selected and these states are termed as economically relevant states for the firm in that particular year.

- A Sample of citation score of states for Coal India Ltd. for year 2014

State	count		
DELHI	37	→	
WEST BENGAL	19	→	
JHARKHAND	17	→	Headquarters State
ASSAM	12	→	
CHHATTISGARH	10	→	
UTTAR PRADESH	10		
MADHYA PRADESH	7		
ODISHA	7		
MAHARASHTRA	6		
HIMACHAL PRADESH	4		
KERALA	4		
GOA	3		
PUNJAB	3		
NAGALAND	2		
HARYANA	2		
KARNATAKA	2		
GUJARAT	2		
BIHAR	1		
ANDHRA PRADESH	1		

For each state a list of companies for which the state is an economically relevant state in a year is made

- A sample of ER Portfolio of Andhra Pradesh

ANDHRA PRADESH
GAIL (INDIA) LTD.18
ITC LTD.18
TECH MAHINDRA LTD.18
POWER GRID CORPORATION OF INDIA LTD.17
ITC LTD.17
GODREJ CONSUMER PRODUCTS LTD.17
TECH MAHINDRA LTD.17
RELIANCE INDUSTRIES LTD.17
ITC LTD.16
TECH MAHINDRA LTD.16
RELIANCE INDUSTRIES LTD.16
ITC LTD.15
TECH MAHINDRA LTD.15
STATE BANK OF INDIA15
TATA CONSULTANCY SERVICES LTD.15
ITC LTD.14
PIDILITE INDUSTRIES LTD.14
TECH MAHINDRA LTD.14

For the securities having 14 in their end, Andhra Pradesh is an economically relevant state for them in the year 2014.

Using the above methodology we find HQ Portfolios and ER Portfolios for states.

### Calculation of portfolio returns:

Returns of each portfolio is calculated by taking the mean of the constituent companies for the corresponding month.

We get mean return for state portfolios- Headquarter portfolio(meanHQ) and ER Portfolio(meanER).

In the taken dataset the headquarters of firms are present in seven states, hence we have a set of seven states having both ER and HQ Portfolios.

### Regression

OLS regression technique is used to make prediction model for predicting returns of headquarter portfolios using market factors namely, Risk free market return, Size Factor, Value factor and Momentum factor along with the mean return of ER Portfolio of same state as independent vectors.

Similarly models for predicting ER Portfolio returns using fama-french four factors and mean HQ Portfolio returns as independent variables are also developed.

## Results

The regression model was made for 7 states namely, Delhi, Maharashtra, Gujarat, West Bengal, Karnataka, Tamil Nadu, Rajasthan. As only these states account for headquarter locations of all the companies in BSE50 index.

In the following regressions, mean monthly return of headquarters portfolio is taken as dependent variable.

### Model: Predicting meanHQ with and without meanER

State(No. Of Headquarters)	Adj R-Squared-Without meanER(R-sq)	Adj R-Squared-With meanER(R-sq)
Delhi(11)	0.794(0.808)	0.798(0.815)
Maharashtra(26)	0.836(0.848)	0.835(0.848)
Gujarat(4)	0.600(0.628)	0.606(0.640)
Tamil Nadu(1)	0.195(0.251)	0.223(0.290)
Karnataka(3)	0.262(0.313)	0.252(0.316)
West Bengal(3)	0.199(0.269)	0.183(0.272)
Rajasthan(2)	0.567(0.597)	0.561(0.599)

The table below shows coefficients and their p-values, depicting significance level of the variable

State	Const.(pvals)	SMB(pvals)	HML(pvals)	WML(pvals)	Rm-Rf(pvals)	meanEr(pvals)
Delhi	-0.21(0.440)	-0.06(0.449)	0.08(0.174)	0.02(0.747)	0.68(0)	0.17(0.171)
Maharashtra	0.26(0.3285)	-0.18(0.013)	-0.13(0.034)	-0.07(0.293)	1.16(0)	-0.07(0.392)
Gujarat	-0.55(0.353)	-0.35(0.027)	0.11(0.397)	0.12(0.399)	1.50(0)	-0.36(0.195)
Tamil Nadu	1.29(0.254)	0.40(0.165)	-0.24(0.324)	-0.21(0.450)	1.52(0.002)	-0.67(0.095)



Karnataka	-1.59(0.084)	-0.24(0.320)	0.09(0.662)	0.20(0.375)	1.18(0.001)	-0.19(0.599)
West Bengal	0.04(0.958)	0.17(0.424)	-0.14(0.439)	-0.21(0.307)	0.55(0.010)	0.05(0.656)
Rajasthan	1.29(0.056)	-0.32(0.085)	-0.05(0.729)	-0.30(0.071)	1.17(0.003)	0.04(0.893)

We observe that, for most of the states there is not any significant rise in prediction efficiency on incorporating meanER portfolio returns in the asset pricing model.

The regression results don't indicate co-variation of ER Portfolio returns and HQ Portfolio returns.

For some states the regression efficiency have improved but p-values for all the regression models indicate that meanER return is not a significant factor in explaining mean HQ Portfolio returns for any of the state.

Next we analyse prediction models for predicting meanER returns using meanHQ returns as an independent variable.

#### **Model: Predicting meanER with and without meanHQ**

State	Adj R-Squared-Without meanER(R-sq)	Adj R-Squared-With meanER(R-sq)
Delhi	0.791(0.806)	0.795(0.813)
Maharashtra	0.684(0.706)	0.682(0.710)
Gujarat	0.803(0.817)	0.823(0.806)
Tamil Nadu	0.587(0.616)	0.601(0.636)
Karnataka	0.576(0.605)	0.570(0.607)
West Bengal	0.235(0.302)	0.220(0.305)
Rajasthan	0.823(0.835)	0.819(0.835)

**Coefficient matrix for model predicting meanER**

State	Const.(pvals)	SMB(pvals)	HML(pvals)	WML(pvals)	Rm-Rf(pvals)	meanHQ(pvals)
Delhi	0.07(0.817)	-0.12(0.131)	-0.14(0.043)	-0.12(0.747)	0.89(0)	0.21(0.171)
Maharashtra	-0.29(0.492)	-0.21(0.065)	0.07(0.449)	0.10(-0.102)	1.17(0)	-0.18(-0.604)
Gujarat	0.21(0.462)	-0.12(0.142)	-0.13(0.041)	-0.02(0.811)	1.17(0)	-0.09(0.195)
Tamil Nadu	-0.34(0.373)	-0.01(0.973)	-0.16(0.048)	-0.11(0.233)	0.96(0)	-0.08(0.095)
Karnataka	0.12(0.832)	-0.16(0.276)	-0.03(0.776)	-0.19(0.161)	1.10(0)	-0.04(0.599)
West Bengal	0.64(0.528)	-0.59(0.037)	0.23(0.339)	-0.01(0.989)	0.66(0.025)	0.10(0.656)
Rajasthan	0.11(0.753)	-0.25(0.009)	-0.04(0.566)	-0.03(0.686)	1.24(0)	0.01(0.893)

Even in the above regression we observe that Risk free market return is the dominant factor explaining returns for ER portfolio.

In the above regression results, we observe that Risk free market return is the dominant factor in explaining the returns of both portfolios while the return from other state portfolio isn't a significant parameter.

Thus, we conclude that citation score is not a good metric for determination of value relevant local information as there is no co-movement between these two portfolios.

### **Further Discussions:**

The result of the analysis indicates that there is no sign of co-movement between HQ and ER Portfolios. Hence, we say that Citation score in annual reports of a firm is not a good measure of value relevant local information availability for indian equities.

We need to look for other parameters such as no. of institutional investors in a state as a metric to determine local information availability.

This research is a small scale version of an big exhaustive analysis, it forms the basis, scaling over which a comprehensive analysis is needed to be performed.

The analysis is done for a set of 50 companies, comprised in the index BSE50. A large scale analysis can provide better results, as using only BSE50 companies doesn't give an exhaustive set of HQ Portfolio and ER Portfolio. A full fledged work can give us a clear picture of whether there is some significant state level geographical co-movement.

An analysis using trading pattern of institutional investors present in the vicinity of Headquarters and Economically important centers of a firm (R&D Office, Manufacturing Unit, Warehouse etc.) and comparing it with overall market movements can prove to be useful for testing whether investors in the vicinity have some informational advantage due to their location. It can also be further extended to look for presence of insider trading

## References:

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(<http://faculty.iima.ac.in/~iffm/Indian-Fama-French-Momentum/>)

Data of all Indian states- <http://districts.nic.in/>