Prediction and Optimization of export opportunities using trade data and product complexity.

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Abstract– The modern portfolio theory explains that investors will invest on the basis of maximizing their profit for their tolerated level of risk or determination percentage of assets in portfolio. It fulfils the investers objective to achieve a safe investment while extracting maximum profit. Product complexity and gravitational theory is directly related to the risk in export of a country. Previous forecasting of export commodties did not take risk factor into consideration which the modern portfolio theory adapts. The proposed research work will focus towards the detection of the export commodities in which investor can have the maximized profit with control on risk by using the past values of trade data, gravitational theory and complexity factor in a way that our system will predict and optimize the exports of a country. The result section elaborates the comparative analysis between Modern Portfolio Theory (i.e Historical, CAP M, Black Litterman) and conventional forecasting models (Holt, Grey) using UN Comtrade dataset. The results indicate that the prediction of modern portfolio methods not only provides more accuracy (i.e MSE between the calculated value and the actual value through Black Litterman is 0.235 and through Holt and Grey is 1.226 and 1.026 respectively) but also shows the level of risk attached to each commodity, hence guiding the investor even further, which is unprecedented. The paper also explains that among all three modern portfolio theories, Black Litterman provides the most comprehensive and accuarate results since the quantitative outcome is based on past data and qualitative outcome comprises of expert views based on gravitational theory, product complexity index, regression and confidence level.

Keywords- Export, Portfolio Theory, Product Complexity , Mean Square Error (MSE), Gravitational Theory, Textile, Black-Litterman Model, Forecasting

Introduction

Countries do not remain in isolation, they have to import commodities to fulfill their requirement which is not produced in the country or in the shortage and in return they export the commodities/goods which are surplus in the country. Export of a country is related to its economic development and an increase in Gross Domestic Product (GDP).

Generalized knowledge of the trade is classified on Harmonized Systems (HS) also knows as Harmonized coding of trade data. This data is classified into a 6-digit level.

During the recent few years, according to the World Trade Statistical Review 2017 [15] by World Trade Organization (WTO), Trade markers convey solicitations and compartment throughput in genuine ports were up in the fundamental quarter of 2017, suggesting more grounded trade improvement for the year, yet the proximity of vital danger factors point to the probability of more negative outcomes.

On account of continuing with a deficiency in the overall economy [14] and low production costs, the volume of world stock trade upheld off to 1.3% in 2016 down from previous 2.6% in 2015. This had a negative impact on global import demand. The world GDP growth since 1980 was 2.8% but ever since it has dropped down to 2.6 in 2016 from the previous 2.7 in 2015, which is below the average. Investment spending has been further weakened due to the slowdown in world trade, due to it being the most trade intensive component of import demand. The merchandise exports have fallen by 3.3% to the US $15.46 trillion in 2016, although the merchandise trade had a slight increase in terms of volume in 2016. The weakest services component of 2016 was transported, which gives a reflection of fluctuations in merchandise trading, the recorded quarterly growth of commercial services trade was just 0.1% in value terms in 2016 adding up to a total of US $4.77 trillion. The economies of developed countries stayed weak throughout 2016 although the developing countries imports had a good recovery in the second quarter from the 3% drop in the first quarter but they managed to recover their previous level by the end of the year. There were several risk factors present in 2016 which pointed to the possibility of less positive outcomes, although trade indicators such as export orders were up during the first quarter of 2017

The most important thing is to identify the gaps and optimize the system that leads towards a better result i.e. increase in GDP through trade. For this problem, the modern portfolio theory explains the optimal portfolio concepts that investor will invest on the basis of maximizing their profit for their tolerated level of risk or determination of percentage of assets in a portfolio such that it fulfils the given objective, maximize return for a tolerated risk and gives a practical result under changing levels of risk and return. Every investor must choose a scenario of a certain amount of risk they can afford to expand their portfolio as showed by this choice. The Fig 1 explains how the optimal portfolio works. Along the line of the curve the ideal risk portfolio is depicted which shows a perfect tradeoff between risk and returns.

Risk mitigation, estimating long term sales growth and generating large amounts of cash are the main objective of product complexity and this information is essential to identify the gaps, predicting the future graphs and optimize the results by integrating the modern portfolio theory. Product Complexity is the quality or state of being composed of two or more separate or analyzable items, parts, or symbols categorized into Multiplicity and Relatedness of the product. Number of components, extent of interaction and degree of product novelty are the factors representing Product Complexity. There is a growing emphasis on product design. The results of product in portfolio are more different and targeted to a more refined market segment. Using Theory Performs Frontier (TPF) and Transaction

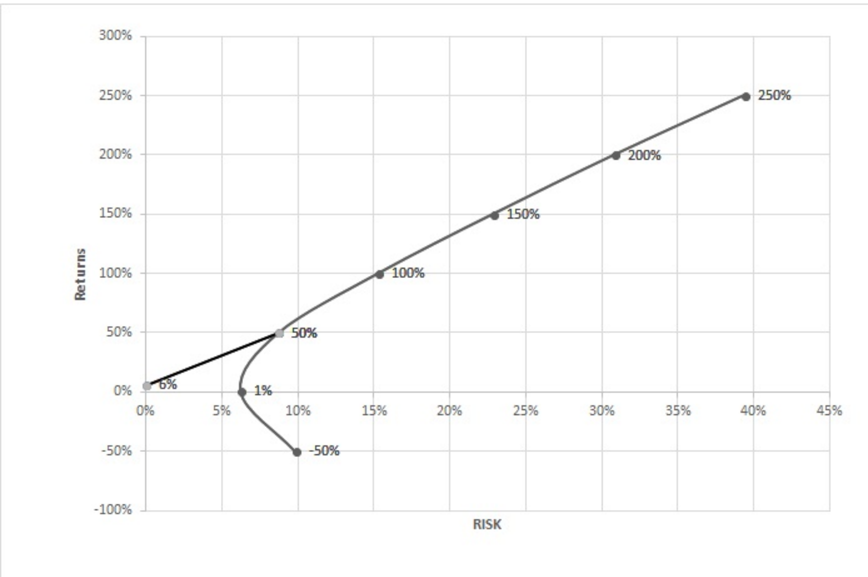

Figure 1: Efficient Frontier of Portfolio

Cost Economics (TCE) as theoretical framework propositions can be constructed that, when tested will advance the theoretical understanding of the impacts of the product complexity on operations.

Product complexity [10] has direct and indirect impacts on trade. It is the state of possessing a Multiplicity of elements manifesting Relatedness which means to assemble a product each and every part is required. Hence more parts in a product the greater the risk of discrepancies. As we increase the product complexity of a product we also tend to increase the lifecycle cost of that product. Several researchers have found that there is an increase in the direct costs due to the increase in product complexity. The more complex a certain product the costlier and complicated it becomes, which increases the direct costs associated with production and development e.g. time, product analysis etc. The more complex and lengthy a product life cycle the more time it takes for the company to develop the product and the greater the risk of mistakes because the number of functions increase as the complexity increases. Not only is the production cycle increased with product complexity but so is the cost, quality, services and customer satisfaction. The set-up costs become higher hence the need for more training and capital. There will be a significant increase in the material costs and labor costs. There are also several indirect costs associated with product complexity. Figuring them out tend to be more difficult. They may incorporate expanding trouble of adjusting the sequential construction systems and item planning. The need for higher quality control arises because of the increase in the components of the product so each and every item needs to be checked. Other factors that can be included are time and capital spent on training, loss of economies of scale, inventory holding costs, time and capital spent on training and learning etc.

The modern portfolio methods used in this research is Markowitz portfolio [9], CAP M. [6] and Black-Litterman [1] model which incorporate qualitative and quantitative analysis on the dataset extracted from UN Comtrade [3]. The database is from United Nations International Trade Statistics. Annual international trade statistic data including details of commodities category with partner country are provided to United Nation Static Division (UNSD) by more than 170 countries. It is the biggest repository of International Trade data. According to policy on use of COMTRADE data clause 3 & 16 by United Nation Department of Economic and Social Affairs Statistic division are permissible. It contains more than 3 billion trade data record since 1962. The paper is classified as follows. Brief background research is provided in Section II that overviews the related work. Section III presents the proposed algorithm used on the dataset. Results and implementation is discussed in section IV and section V gives the analysis of results and future work.

Background/ related work

WLi Xia et al have forecasted garments & textile exports based on Holt Model in 2010 [16]. They Predicted China Export Using export data from 1992 to 2008 to predict 2009 and 2010 and by using Trade data 1992 to 1999 they predicted 2000 and 2001 for verifying prediction accuracy. If verified Using export data till 2008 predict 2009 and 2010 and verify error in an allowed range Similarly Pedro Uribe et al [17] have done informational approach to the forecasting of inter-regional trade flows in 1966. They have separated the world into n areas and took add up to exports to and add up to imports from every locale and connected RAS method and the forecast methodology to import and fare information of the years 1938, 1948, 1951-52 and 1959-60 of the accompanying 8 districts i.e. Germany, North America, Latin America, Other European Economic Community nations, United Kingdom Other European free trade association nations, Communist nations and Rest of the world.

Fanxing Kong et al forecast China export by applying GM(1,1) model[21]. They have taken the trade data from 1999 to 2008 to verify the model by comparing the prediction accuracy. They predicted for the next three to five years and discovered piece of clothing still developed quickly in three to five years. Articles of clothing of China upgraded in quality as well as broadened the interest in plan, quality, and brand to contend the piece of clothing industry. Zhang Dabin et al [22] forecasted custom export of China based on Grey theory. They have utilized the Hubei Province China export data from 2000 to 2008 and predicted 2009, they showed GM model can forecast export of Hubei province better than econometric model, monetary emergency on the worldwide economy has impacted these years however Chinese government can export trade by changing arrangements and oblige ventures and give chances to a financial specialist to contribute and assemble well-disposed association with principal businesses of created nations.

Yan Xie et al [18] predicted the aggregate volume of trade based on optimized genetic algorithm on grey modelling. He presented a technique in view of hereditary calculation streamlining displaying process. This technique makes full utilization of the benefits of the Grey model estimate and qualities of hereditary calculation to discover worldwide enhancement. The model presented is more precise as per information from an area, the grey model shows for anticipating the total volume of import-send out exchange was given in view of the dark framework speculations and hereditary calculation. The outcome shows that the model can be utilized as the total volume of import-send out exchange a successful device for gauging. Trade data is of the china province from 1989 to 2004 and predicted 2005 to 2007, decreased the error from 33.68%, 43.61%, 51.10% to 6.82%, 2.40, 9.04 for the year 2005, 2006, 2007 accordingly. Finally concluded if the parameters 'u' and 'a' of grey model is optimized by genetic algorithm, GM (1,1) model accuracy for medium and long term increased.

Chi-Chen Wang et al [2][7] gives the comparison between MFTS and traditional time series modelling to forecast china exports and later applied the same techniques on the export of Taiwan. Data is fetched from state administration of foreign exchange from January 1995 to October 2002, predicted MFTS prediction is more accurate for short term forecasting than traditional time series while one variable MFTS model perform better forecasting accuracy than multi variable. Comparative analysis of ARIMA, ARMA Two Factor model, Heuristic model and Markovitz model are performed by using China export data from January 1995 to October 2002, subdivided into January 1998 to October 2002 and January 2000 to October 2002. Heuristic model shows the better forecasting result followed by Markowitz model. In other papers the Taiwan trade data from January 1990 to April 2007 and subdivided into 3 categories. (1) August 1998 to April 2007 (2) December 2002 to April 2007 (3) February 2005 to April 2007.The MSE value of ARIMA model is the lowest in (2 & 3), ARIMA model has better forecasting ability in long-term period MFTS model performs better prediction ability for a short-term data than long-term.

To comprehend example of exchange a globalized world, business analysts tend to utilize the gravity model. This was first displayed in 1962 by Jan Tinbergen, who suggested that the span of reciprocal exchange streams between any two nations can be approximated by utilizing the 'gravity equation', which is gotten from Newton's theory of gravitation. Relative size is dictated by the present GDP, and financial vicinity is controlled by profession costs – the all the more monetarily "distant" the more prominent the trade costs. Thomas Chaney in 2011[20] gives the brief explanation on the Gravity Equation in International trade, similar papers regarding gravity model have been written [8] [12] Despite all no previous work with respect to export opportunity decision based on predictive return vs risks has been carried out.

Proposed algorithm

In the proposed look into work Markowitz Portfolio Optimization and Black-Litterman display has been actualized for the expectation. Export using Gravitational theory and Product complexity data for the expert to incorporate their views.

MARKOWITZ PORTFOLIO OPTIMIZATION

Suppose there are N commodities. let $\mathbf{r}_{\mathrm{ct}}$ be the return at time $\mathbf{t}$ on an invested as per dollar in a commodity $\mathbf{C}$; let $\mathbf{d}_{\mathrm{ct}}$ be the rate of return of commodity C at time t; Let $\mathbf{W_c}$ be

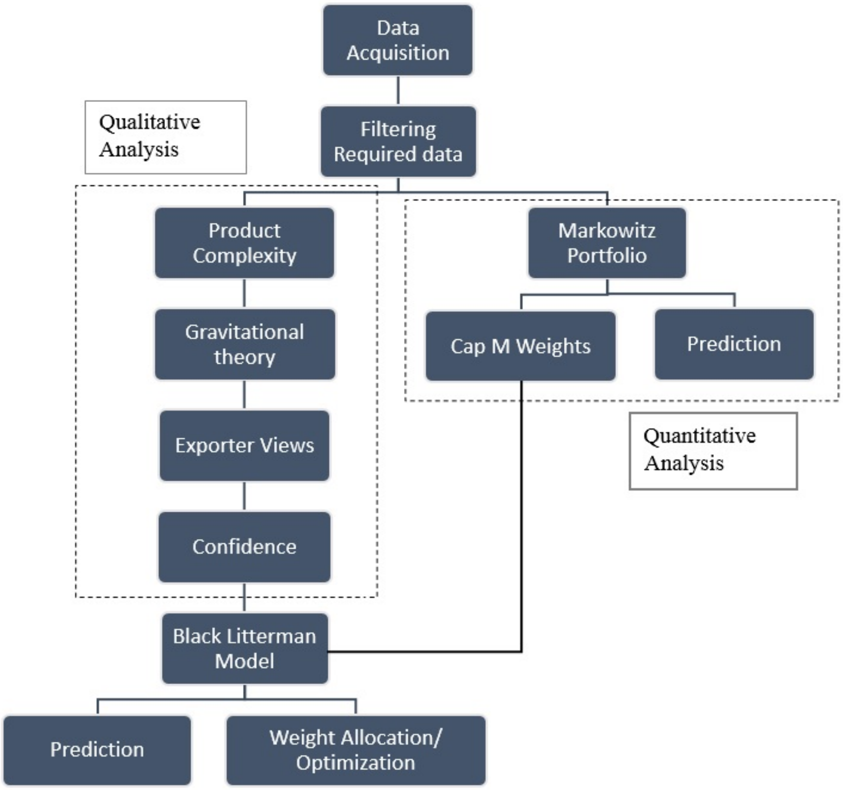

Figure 2: Proposed Algorithm of overall system

the weightage of investment in commodity C. Then the overall return **R** of the portfolio is:

$$R = \sum_{c=1}^{N} W_c \left(\sum_{t=1}^{\infty} d_{ct} r_{ct} \right)$$

$\mathbf{R_c} = \sum_{\mathbf{t=1}}^{\infty} \mathbf{d}_{ct}\mathbf{r}_{ct}$ is the return of $\mathbf{c}^{th}$commodity, Therefore

$R == \sum XcRc$

In this equation $\mathbf{X_c}$ and $\mathbf{R_c}$ are independent.

Since $\mathbf{X_c} \geq \mathbf{0}$ for all **C** and $\sum \mathbf{X_c} = \mathbf{1}$ for maximize return.

$$sum_{a=1}^{K} X_{c_a} = 1$$

For several investments amount a= 1, ..., K for maximum returns.

Let X be the random variable, suppose X series of finite number value $\mathbf{x_1}, \mathbf{x_2}, \ldots, \mathbf{x_N}$, Suppose the probability that $\mathbf{X} = \mathbf{x_1}$ be $\mathbf{p_1}$and $\mathbf{X} = \mathbf{x_2}$be $\mathbf{p_2}$.

The Expected value or μ(mean) [5] of X defined as:

$E = p1x1 + p2x2 + [?] \ldots\ldots. + pNxN$

The Variance of X is defined as

$V = p1(x1 - E)2 + p2(x2 - E)2 + [?] \ldots\ldots\cdots + pN(xN - E)2$

V is the average square deviation of X from its μ mean, we can calculate standard deviation as $\sigma = \sqrt{V}$ and the coefficient of variation, $\frac{\sigma}{E}$.

Suppose Y_1, Y_2 , ..., Y_N are a number of random variable, If Y is the weighted sum of Y_i then,

$Y = a_1 Y_1 + a_2 Y_2 + ...+ a_n Y_N$

E

$$(Y) = a_1 E\left(Y_1\right) + a_2 E\left(Y_2\right) + \ldots\ldots + a_N E\left(Y_N\right)$$

Above equation is Expected value of the weighted sum of a random variable, proof6

For variance we define covariance σ_{ij} between $Y_i \&;\ Y_j$as:

$$sigma_{\text{ij}} = E\left\{\left[Y_i - E\left(Y_i\right)\right]\left[Y_j - E\left(Y_j\right)\right]\right\}$$

The covariance between two random variables is equal to the correlation ρ_{ij} times the standard deviation of two variable

$$sigma_{\text{ij}} = \rho_{\text{ij}} \sigma_i \sigma_i$$

Correlation coefficient (ρ_{ij}) measures the relative covariance between the commodities returns. The range of ratio is limited by +1.0 and -1.0, $(\rho_{\text{ij}}) = +1.0$ Positive Correlation which means at the same span of time returns on two commodities try to moving in same direction. ρij = -1.0 Negative Correlation which means at the same span of time returns on two commodities try to moving in opposite direction. When the return of one security increases results in decrease in second negative correlated security. This negative Correlation results in a negative corelated coefficient. $(\rho_{\text{ij}}) = 0.0$ Zero Correlation which means at the same span of time returns on two commodities are independent and cannot move in same or opposite direction.

Variance of weighted sum is:

$$(Y) = \sum_{i=1}^{N} a_i^2 V\left(W_i\right) + 2 \sum_{i=1}^{N} \sum_{i>1}^{N} a_i a_j \sigma_{\text{ij}}$$

We know Y_i is σ_{ii} therefore,

$$(Y) = \sum_{i=1}^{N} \sum_{j=1}^{N} a_i a_j \sigma_{\text{ij}}$$

Let R_c is the return on the c^{th} commodity. Let μ_c be the expected return of R_c, σ_{cs} = covariance between R_c & R_s, σ_{cc} = variance of R_c, W_c = percentage weightage of investor of R_c, then,

$$R = \sum R_c W_c$$

The R_c similarly R are random variable and (R) return on the portfolio is a weighted sum of R & R_c. W_c are the percentage of investment., $\sum W_c = 1$ shows sum of all investment is equal to (1). Therefore, Expected Return & Variance of the portfolio is:

$$E = \sum_{c=1}^{N} W_c \mu_c$$

$$V = \sum_{c=1}^{N} \sum_{s=1}^{N} \sigma_{\text{cs}} W_c W_s$$

BLACK-LITTERMAN MODEL

We are multiplexing both approaches for the best results because as per search, Trade has a good influence of Government policies and an expert opinion. Optimal portfolios are very sensitive for the inputs, for the small value change can result a high impact on optimizations shows a small change in expected returns produces a drastic change in the composition of the portfolio. This model is presented by Fishcer Black and Robert Litterman in 1992, author has invert Optimization keeping in mind the end goal to touch base at a gauge of Implied Equilibrium Excess Return and they enable us to join our Views about different asset and certainty about our perspectives to produce the normal returns vector. Notion of Implied equilibrium return is a utility function of investor is

$$U = W^T R - \frac{1}{2} A W^T \mathrm{SW}$$

Where, A= Risk Aversion, R= Risk, S= Variance Co-Variance matrix, w= weights $\sum W$=1

$$frac\mathrm{dudw} = R - ASW = 0$$

Rather solving for weights, they argued that weights are already observed in the market therefore
they compute them using market capitalization.

$$R = ASW$$

$$A = \frac{E\left(r_m\right) - r_f}{\sigma_m^2}$$

$$M = \left[(\tau\ S)^{-1}\ +\ P^T\ \Omega P\right]^{-1}$$

$$E(R)\ =\ \left[(\tau\ S)^{-1}\ +\ P^T\ \Omega P\right]^{-1}\left[(\tau\ S)^{-1}\ \Pi\ +\ P^T\ \Omega Q\right]$$

τ = Scalar number indicating uncertainty usually range (0.025 to 0.05)

$\Pi = ASW_{mkt}$
M= Uncertainty of Returns, Π= Implied Equilibrium Return
P = Investors views matrix; each row a particular view of the market and each element of the row represents the portfolio weights of each asset (KxN matrix)
Q = The expected returns of the portfolios from the views depicted in matrix P (Kx1 vector)
Ω = A diagonal covariance matrix with elements of the uncertainty inside each view (KxK matrix)

S_B= $S + M$
S_B=Variance covariance Matrix of Black-litterman model
Assuming there are N commodities in the portfolio this formula will calculate
new expected return.

PRODUCT COMPLEXITY INDEX

There are just a few researchers like Bashir and Thomson that have actually come up with a quantitative measurement for product complexity. In this method they have based complexity on the number of product functions and the level at which they appear in a decomposed function tree Accordingly, total complexity is measured by:

$C_T = \frac{w_1 C_m + w_2 C_p + w_3 C_{st} + w_4 C_s}{w_1 + w_2 + w_3 + w_4}$

C_m= f(material, tooling, geometry, process,, C_p=f(geometry), C_{st}=f(number of sub-assemblies, levels in hierarchy, max number of components / sub-assemblies)

C_s=f(number of assembly operations,

w_t= numerical contraints, where $i = 1, 2, 3, 4$

Noting most of the variable in this measurement are identified by design and production ratings. From the above, the optimum number of components can be found by:

$$fracdC_T\mathrm{dn} = \frac{d}{\mathrm{dn}}\left(\frac{w_1 C_m + w_2 C_p + w_3 C_{\mathrm{st}} + w_4 C_s}{w_1 + w_2 + w_3 + w_4}\right) = 0$$

GRAVITATIONAL MODEL

General Trade Gravity model is expressed as:

$Y_{IJ} = G\frac{X_I X_J}{D_{IJ}}$

$$lnY_{\mathrm{IJ}} = \alpha_0 + \alpha_1 \ln X_I + \alpha_2 \ln X_J + \alpha_3 \ln D_{\mathrm{IJ}} + \epsilon$$

Where 'I' denotes Pakistan and 'J' signifies bringing in nations, Y_{ij} means the export volume, D_{ij} shows the distance between the two nations, $X_i \&$; X_j speaks the export and import country's GDP. The conventional Trade Gravity Model proposes that exchange streams between the two nations are emphatically identified with the GDP of the two nations and contrarily identified with the separation between the two nations.

Implementation and results

For implementation, various qualitative and quantitative analysis are extracted from the COMTRADE dataset using the Markowitz portfolio [9], CAP M. [6] and Black-Litterman [1] model. Each result from the dataset is compared with the actual result to conclude the best model.

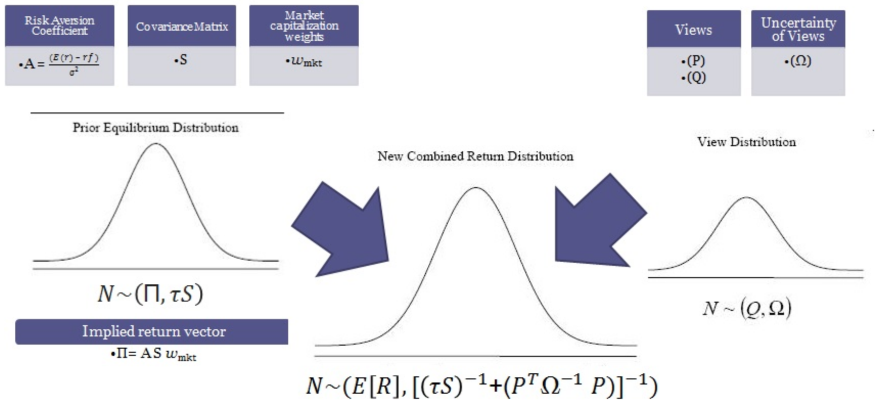

Figure 3: Prediction Approach

DATA ACQUISITION:

It incorporates the way toward securing the exchange information of the required Commodity. In our case, we are using HS [6 digit code] database. All the Commodity have data ranging from the year 2003 to 2016. There are 23 textile commodities which are more than 0.5% in a total textile export of Pakistan. The data acquired is from United Nation Commodity Trade Statistics Database as their source is Pakistan Bureau of Statistics. Further acquired data filtered and fetch the required information for further process

QUALITATIVE ANALYSIS:

This process includes in calculating Product complexity Index, finding gravitational trade model impact and construct an expert view matrix P and Q on the basis of the knowledge of above-defined factors. With the View matrix writer has constructed the uncertainty of matrix \Omega$\Omega$. Series refers to the commodity of trade.

$\Omega = tPSP^T$

QUANTITATIVE ANALYSIS :

Using the filtered trade data, calculating expected return from the historical commodities value. Total expected return from the year 2003 to 2016 calculated by

TABLE I. EXPECTED RETURNS OF YEAR 2015 USING DIFFERENT PORTFOLIO OPTIMIZATION MODELS

S no	**Commodities**	**Historic Returns**	**Cap M Returns**	**BLM Returns**	**Actual Returns**
1	520512	8.17%	-0.08%	-46.88%	-20.34%
2	630260	7.44%	3.41%	41.80%	-5.33%
3	630231	-1.86%	3.12%	-15.63%	3.81%

S no	Commodities	Historic Returns	Cap M Returns	BLM Returns	Actual Returns
4	620322	93.07%	3.71%	314.06%	255.38%
5	630239	26.81%	6.95%	10.16%	10.86%
6	630210	20.91%	4.33%	-67.19%	-7.30%
7	620342	7.33%	2.99%	-20.63%	-28.64%
8	520942	25.50%	3.13%	51.56%	3.28%
9	630710	7.63%	2.75%	-14.45%	-3.01%
10	620462	20.94%	9.35%	13.67%	-30.71%
11	610590	44.80%	16.88%	89.06%	-3.63%
12	610510	-6.41%	4.24%	-22.66%	-12.67%
13	610910	3.42%	2.33%	10.01%	0.66%
14	520812	147.61%	35.54%	46.88%	-14.46%
15	520932	86.74%	-0.12%	-12.50%	-1.13%
16	610349	108.22%	4.84%	28.13%	17.25%
17	611090	62.97%	5.52%	3.13%	16.40%
18	520912	345.58%	27.76%	75.00%	-19.17%
19	520532	21.32%	14.40%	2.73%	-15.31%
20	610339	160.90%	11.72%	43.75%	13.75%
21	521021	5.76%	-0.12%	-3.13%	1.55%
22	551341	72.26%	-1.01%	-56.25%	-24.19%
23	521011	37.80%	20.59%	0.00%	0.90%

Using approach of Black-Litterman [1] model in Figure 3, Expected Returns on 23 Textile Commodities of Pakistan of the year 2015 using trade data from the Year 2003 to 2014, calculated returns shows on Table I. Figure V, VI & VIII represents Efficient Frontier of Expected and the actual returns VS risk of the year 2015 using Markowitz, Cap M & Black-Litterman Model accordingly, hence proving standard error can be minimize by incorporating expert views in Black-Litterman model. This approach results maximizing profit with control of risk on the trade. Figure VII represents the uncertainty of returns with respect to each commodity. Figure IX represents the comparative analysis and represents trade data is exceedingly nonlinear, therefore expert views based on gravitational theory [12][20], product complexity index [4][19], regression and confidence level gives the lowest Mean Square Error (MSE). Secondly the Black-Litterman model deals with the two parameters which is Return & Risk, which is advance version of previous work that were able to present with one dimension which include return thus it scientifically decreases our error rate in comparison to other models. Table II represents the expected return for the predicted year 2016 of the 23 textile commodities of Pakistan and the weightage allocation for maximum return, minimum variance and maximum sharp ratio.Figure X is the efficient frontier graph of 2016 predicted returns vs risk using Black-Litterman model.

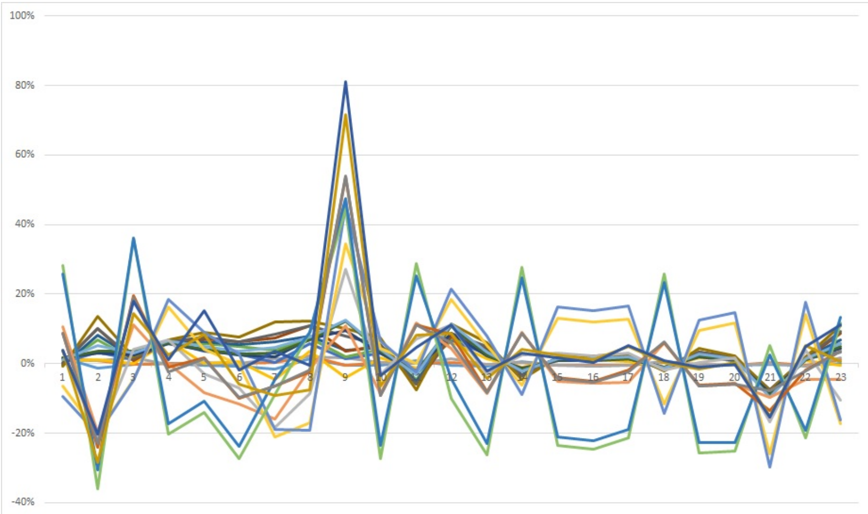

Figure 4: Uncertainty of Expert Views of 23 commodities

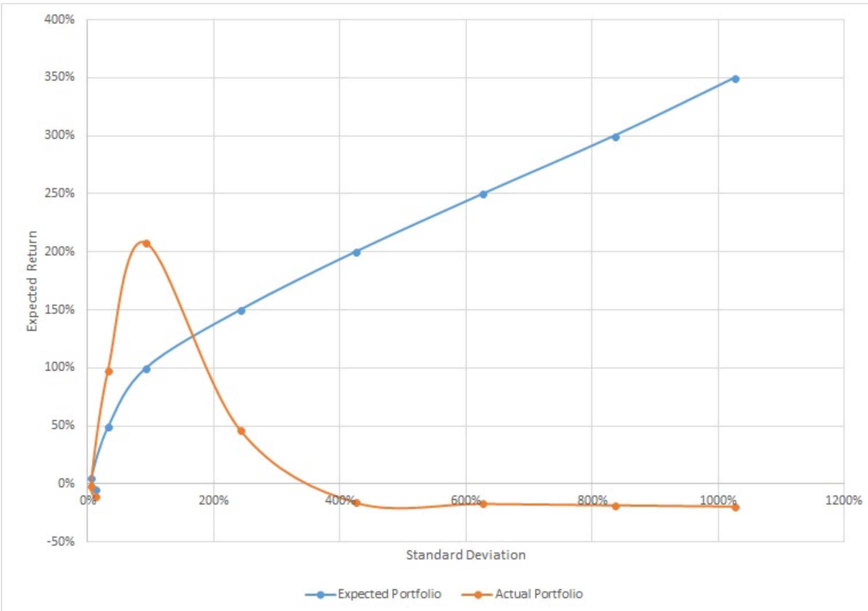

Figure 5: Efficient Frontier of Markowitz Model

TABLE 2 EXPECTED RETURNS & WEIGHTAGE ALLOCATION OF YEAR 2016 USING BLACK-LITTTERMAN PORTFOLIO OPTIMIZATION MODELS

S no	Commodity	Expected Return	Weights for Max Return	Weights for min Variance	Weights
1	520512	10.67%	0.00%	16.16%	20.24%

S no	Commodity	Expected Return	Weights for Max Return	Weights for min Variance	Weights
2	630260	3.07%	0.00%	24.91%	14.45%
3	630231	-0.61%	0.00%	22.34%	1.60%
4	620322	-19.85%	0.00%	1.54%	0.00%
5	630239	3.47%	0.00%	0.00%	0.00%
6	630210	4.66%	0.00%	0.00%	0.00%
7	620342	4.22%	0.00%	0.00%	9.20%
8	520942	10.33%	0.00%	0.00%	0.00%
9	630710	0.53%	0.00%	19.83%	0.00%
10	620462	11.47%	0.00%	0.00%	6.81%
11	610590	12.43%	0.00%	0.00%	0.00%
12	610510	0.94%	0.00%	0.00%	0.00%
13	610910	1.09%	0.00%	12.40%	0.00%
14	520812	22.13%	100.00%	0.00%	0.00%
15	520932	6.52%	0.00%	0.00%	0.00%
16	610349	-13.48%	0.00%	0.00%	0.00%
17	611090	-3.17%	0.00%	0.00%	0.00%
18	520912	-17.77%	0.00%	0.00%	0.00%
19	520532	5.96%	0.00%	0.00%	0.00%
20	610339	-15.72%	0.00%	0.00%	0.00%
21	521021	4.32%	0.00%	2.66%	0.54%
22	551341	-7.91%	0.00%	0.16%	0.00%
23	521011	18.63%	0.00%	0.00%	0.63%

Acknowledgment

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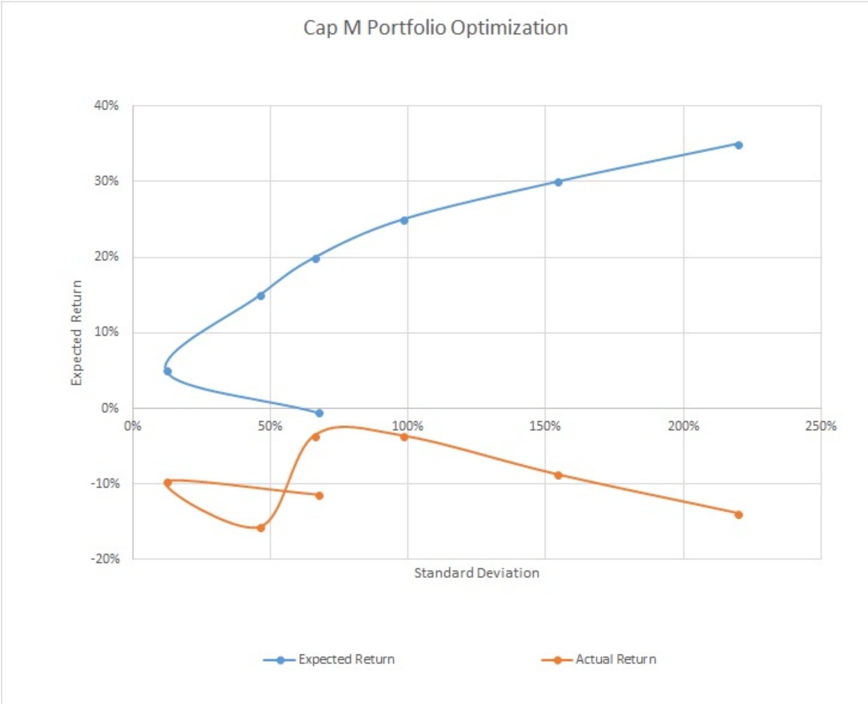

Figure 6: Efficient Frontier of CAP. Model

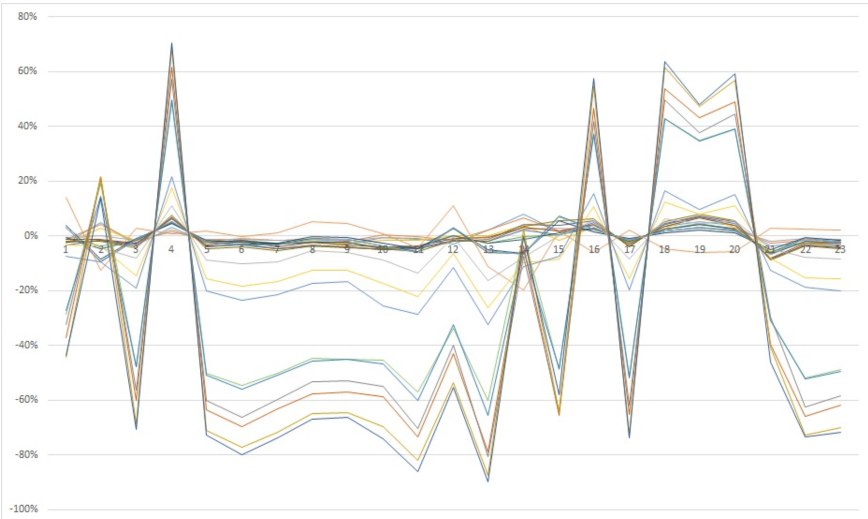

Figure 7: Uncertainity of Return

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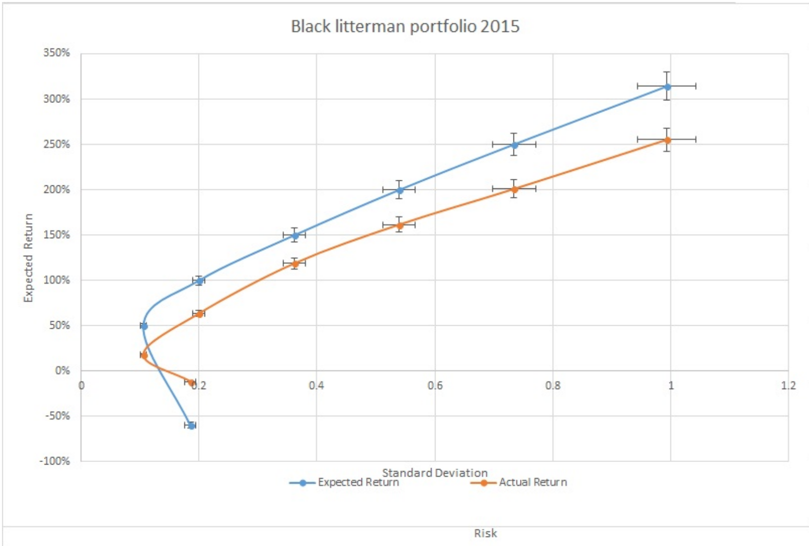

Figure 8: Efficient Frontier of Black-Litterman Model

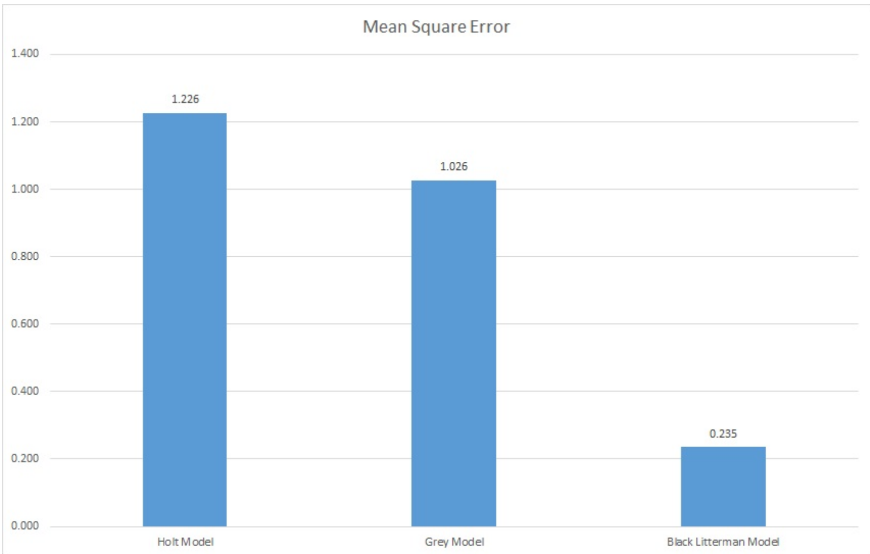

Figure 9: Comparative Analysis of Black-Litterman MSE with Holt & Grey Model

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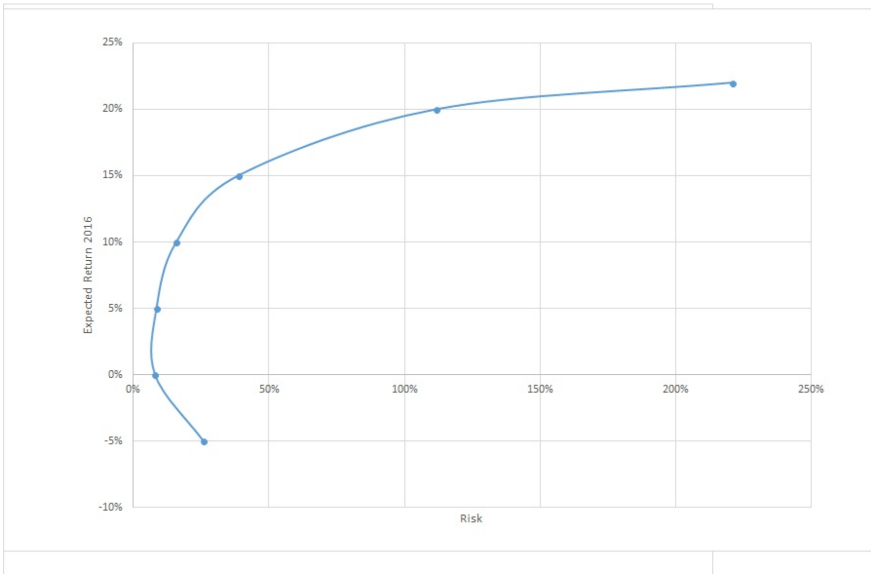

Figure 10: Efficient Frontier For the Predicted year 2016 using Black-Litterman Model

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