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Corporate Financing and Firm Efficiency: A Data Envelopment Analysis Approach

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This study investigates the endogenous determination of firm efficiency and leverage while testing the competing hypotheses of agency cost, efficiency-risk and franchise-value, in a sample of 136 non-financial firms listed on the Pakistan Stock Exchange (PSX), over the period 2002 to 2012. Data Envelopment Analysis (DEA) method is employed to measure firm efficiency as proxy for firm performance. The endogenous nature of firm efficiency and leverage allowed using two-stage least square (2SLS) technique. The findings of the efficiency equation suggest that leverage has a significant positive effect on firm efficiency. Additionally, firm risk, growth rate, size, board size and board composition positively affect firm efficiency. On the other hand, the results of the leverage equation suggest that firm efficiency has a significant negative effect on leverage. Firm size and CEO duality have positive effects on leverage while firm age, board composition, institutional ownership, managerial ownership and asset tangibility have negative effects on leverage. Generally, the results support agency cost and franchise-value hypotheses that higher leverage improves firm efficiency while higher firm efficiency results in reduced leverage.

Keywords: Leverage, Firm Efficiency, Capital Structure, Firm Performance, Data Envelopment Analysis

1. INTRODUCTION

Jensen and Meckling (1976) argued that managers are guardians of their shareholders' interests and they strive to maximise the firm's value. An agency problem, however, arises if managers serve their own interest instead of shareholders'. Adam Smith (1776) argued that multiple and diverse ownerships result in reduced performance of the firms as the manager of a firm may not look after the firm's operations with the same motivation as that of its owners. This insight became the basis and motivation for the work of Jensen and Meckling (1976) that resulted in abundant research work on corporate financing, in the context of agency theory. Within the principal-agent framework, the agency theory predicts that the agent tries to benefit from firm's resources and consequently the firm incurs cost which eventually reduces the firm value. On the other hand, the principal tries to reduce the possibility of incurring those costs by establishing various mechanisms. The agency theory provides a basis for studying contractual relationship between managers and shareholders. Both are considered as individuals maximising their own utility. Thus, shareholders use certain mechanisms that

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will lead to reduction in the agency costs. One such mechanism is the use of leverage in the capital structure of a firm.

The agency theory proposes that the choice of debt/equity mix helps in mitigating agency costs [Berger and Bonaccorsi di Patti (2006)]. Higher leverage can reduce agency costs but it may increase bankruptcy costs. Higher leverage may force managers to enhance firm performance by generating additional gains to support debt holders [Jensen (1986)]. Jensen and Meckling (1976) discussed that at a lower level of debt ratio, the agency costs positively affect firm performance and decrease total agency costs, while bankruptcy is likely when the leverage reaches a certain level and the costs of outside debt may be higher than the outside equity, resulting in higher total agency costs. Risk of default may result in conflict between debt holder and shareholder. Myers (1977) termed it as 'underinvestment' which may result in increased risky financing by the managers.

Leibenstein (1966) debated on the firm value by assuming the actual and expected output in terms of performance measured as efficiency. He noted that how difference in interests of the manager and shareholder results in an inefficiency of the firm. The work of Leibenstein (1966) is said to be in line with the view of employing leverage as an agency-cost mitigating device and importance of these costs in attaining the firm's optimal capital structure [Jensen and Meckling (1976); Myers (1977)]. Extant literature lacks evidence on the proxies for measuring performance of the firms which are in line with the definition of agency costs [Berger and Bonaccorsi di Patti (2006)].

In view of the above discussion, this study considers diverse characteristics of the firm to determine firm efficiency, in order to observe the implicit effects on the firm value. The aim is to establish the best-practice frontier of efficient firms and other inefficient firms as a distance from the frontier. The efficiency of the firms allows for examining its effects on the capital structure, by testing two hypotheses i.e. efficiency-risk and franchise value. The former is concerned with employing higher leverage in the capital structure as higher efficiency allows decreasing the costs associated with the leverage. The latter is concerned with choosing lower leverage as to preserve the benefits of higher efficiency and avoid possible bankruptcy [Margaritis and Psillaki (2007)].

The main objective of this study is to examine the endogenous role of leverage and firm efficiency by using an alternative measure of profit efficiency i.e. Data Envelopment Analysis. In doing so, we test several hypotheses of agency theory which are discussed in the preceding paragraphs. Moreover, we account for the problem of endogeneity by estimating two-stage least square (2SLS) regression and model the relationship between various variables, in a manner that is consistent with the suggestions of Margaritis and Psillaki (2007).

As opposed to previous studies, this study uses DEA which excludes the factors not related to agency costs [Berger and Bonaccorsi di Patti (2006)]. We expect that this study will enable local and foreign firms to have information about the corporate environment in terms of efficiency of the firms in Pakistan. Moreover, this study also shows how principal-agent problems can be minimised to enhance firm performance. In other words, this study is based on the competing hypotheses of agency cost, efficiency-risk and franchise-value. The study contributes to the literature in the following ways: first, we employ latest measures of efficiency as opposed to the traditional measures of firm performance; second, we assess whether the gap between the efficient frontier and other frontiers is a basis of choosing debt over equity or vice-versa.

The rest of the paper is organised as follows. Section 2 presents the literature review focusing in particular on different aspects of corporate financing including performance of the firm. Section 3 presents details about research methodology and methods for collection and analysis of the data. Section 4 spells out findings and interpretation of the data analysed. Section 5 concludes the discussion.

2. RELATED LITERATURE

The relevance of capital structure to firm's output efficiency can be explained in terms of the agency theory. Since managers are expected to maximise their own utility rather than increasing the firm value; shareholders need to use mechanisms that can force managers to maximise the firm value. One such mechanism might be the use of debt-financing. For example, Jensen (1986) argued that firms with excessive free cash flows are exposed to the risk of sub-optimal utilisation of these cash flows at the hands of managers. Therefore, if shareholders force a higher leverage ratio, then the firm will use cash for debt-servicing. This will limit the sub-optimal utilisation of the free cash flows. Below, we first discuss the agency problems and then focus on how such problems can be solved using leverage.

2.1. Agency Problems

The first agency problem '*lack of interest*' was identified by Smith (1776). He discussed that managers could not be expected to look after the operations of a business with the same interest and vigilance as the business owners. Berle and Means (1932) added to Smith's idea and argued that dispersed ownership has negative implications for firm value. Dispersed ownership extends supreme authority to the management to control the affairs of the firm. This creates a situation of opportunism for the managers to extract rents. They suggested concentrated ownership as an alternative to the dispersed ownership, in which case the managers cannot expropriate wealth away from shareholders. Later on, Jensen and Meckling (1976) highlighted the agency costs of equity.

Agency theory can solve two problems; risk sharing i.e. the difference in attitudes of two parties towards risk and agency problem i.e. different goals of two cooperating parties. The former problem arises when the agent and principal are aligned to different risk-taking choices and it then leads to the second problem i.e. agency problem. The more the number of fixed claimants, receiving a fixed amount, the more funds will be used to satisfy their claims. However, the use of more funds results in less retained earnings and/or free cash flow which leads to insolvency/illiquidity of the firm that forces the firm to go for external costly financing.

2.2. Capital Structure and Firm Efficiency

The area of capital structure and firm efficiency has attracted the attention of researchers in recent times. Few notable studies include Weill (2003); Margaritis and Psillaki (2007), Margaritis and Psillaki (2010), Cheng, *et al*. (2011) and Dawar (2014). Margaritis and Psillaki (2007, 2010) employed firm efficiency as a proxy for firm performance. They investigated the possibility whether firms can produce more output(s) with less input(s) in the presence of debt financing. They argued that the capital structure

plays a crucial role in determining the firm efficiency. The linkage between these two variables can be studied through agency theory. It refers to the conflicts based on interests between the managers, creditors and shareholders. Grossman and Hart (1982) argued that in the presence of little or no leverage, managers do not face much stress if they produce poor financial results. On the other hand, if the risk of default is high, it can motivate managers to work hard and increase efficiency to avoid bankruptcy. Recent papers provide support for the above argument. For example, Shah, Shah, Smith, and Labianca (2017) reported that managers perceive higher leverage in the presence of more efficient judicial systems as a serious threat to the continuation of their jobs or private benefits. In other words, debt financing can discipline managers which can result in better performance. Therefore external financing, including debt financing may restrict the manager's opportunism and discretion [Jensen (1986)]. The idea is to subject managers to the scrutiny of external capital markets, reduce the free cash flows under the discretion of the mangers, and put managers under constant pressure of regular payment of debt financing. Resultantly, it is expected that leverage will increase a firm's efficiency.

2.3. Control Variables

There are several control variables which may affect firm performance other than leverage. The following variables are most commonly used in studies of capital structure.

2.3.1. *Ownership Pattern and Efficiency*

The extant literature shows that agency problems can be controlled by changing the ownership structure of firm. For example, Jensen and Meckling (1976) suggested that agency problems can be reduced by increasing the ownership stake of managers. However, La Porta, *et al*. (2001) argued that insiders with significant shareholdings can easily expropriate minority shareholders. Similarly, Demsetz (1983) showed that increasing managerial ownership in the firm can invite the adverse impact of managerial entrenchment. On the link between ownership structure and firm performance, Shleifer and Vishny (1986) suggested that large shareholders can reduce agency costs as these shareholders can better monitor and discipline managers.

2.3.2. *Asset Structure*

Asset structure plays a key role in determining corporate financing. Compared to growth opportunities, tangible assets have more stable value at the time of default and hence are more useful to creditors [Titman and Wessels (1988)]. Firms with higher asset tangibility are expected to acquire more debt due to the ability to acquire debt at lower interest cost, considering that debt is backed by the assets. Shyam-Sunder and Myers (1999) showed that leverage and tangibility are positively associated. Several studies from Pakistan report similar association.

2.3.3. *Firm Size*

Larger firms are said to be less vulnerable to risk due to their diversification and resource endowments. Diversified product portfolio helps them to have a stable flow of funds which in turn helps in neutralising the possible negative effect of debt on the firm.

This factor gives larger firms an upper hand over smaller ones to easily acquire the debt directly or through collateral. Further, the creditors are expected to extend credit to larger firms as the recovery chances are high [Hall, *et al.* (2004)].

The size factor can influence the firm profitability as well, which in turn allows larger firms to choose the levels of internal and external financing. Furthermore, larger firms enjoy better economies of scale, can use advanced technology, spend well on research and development and attract and maintain qualified employees. These factors help larger firms to be more profitable over a longer period. Abdullah, Shah, and Khan (2012) used a sample of 183 firms listed at the Pakistan Stock Exchange over the period 2003 to 2008 and found that firm size has a positive effect on return on assets (ROA), an accounting-based measure of firm performance.

2.3.4. *Firm Age*

The survival of a firm in the market over a long period confirms that the firm has developed a reputation in the market. The experienced and reputed firms are expected to have easy access to external finance. This also attracts external monitoring of the firm which reduces the firm agency costs. Therefore, firm's age is expected to have a positive association with leverage and firm performance [Hall, *et al*., (2004)]. For a sample of PSX listed firms, Shah, Khan, and Afraz (2017) found that the implied cost of equity (an indication of the business risk of a firm) decreases as a firm passes through different stages of its life cycle, such as growth, maturity and stagnancy.

2.3.5. *Board Size*

The extant literature reports mixed evidence on the effectiveness of board size in reducing agency problems. Several studies report that larger boards can devote more time to monitoring managers' activities, can bring in diverse experience and knowledge [Bacon (1973); Herman (1981)], and can effectively allocate workload among board members. Singh and Davidson (2003) reported that larger boards are negatively associated with asset utilisation. However, they do not contain managerial expenses. This implies that larger boards fail to effectively monitor and control agency costs.

2.4. Institutional Investors and Capital Structure

Small shareholders own a small chunk of shares of the firm and may not be motivated to look after the day-to-day operations of the firm. They may not have the resources i.e. time, skill and willingness to monitor the managers of the firm. This leads to a problem which is commonly known as free rider problem [Shleifer and Vishny (1997)]. Small investors are considered to accept whatever the firm offers them. Additionally, any initiative by the small investors cannot solely go in their favour, as non-small investors with a stake and interest in the firm get benefit from it. The presence of large investors can overcome this problem as they have financial incentives to oversee the management of the firm. Moreover, these shareholders are able to elect board members and also can get themselves onto boards to closely monitor managers of the firm. The internal boards are expected to work and deliver in an acceptable manner when there is a presence of outside control [Denis, Denis, and Sarin (1997)]. Thus, the purchase of shares in bulk by the outsiders can act as a threat to discipline the management. The

performance of the managers produces turnovers and maximises the firm value in the presence of large investors and as a result of increased possibility of a threat of takeover [Denis and Denis (1995)]. The large shareholders also pressurise the management to avoid financing the projects to diversify the risk, as bulk of their money is at stake in a single firm whose diversification does not suit them which yields lower benefits.

3. DATA AND METHODOLOGY

3.1. Data and Sample

This study uses the financial data of 136 non-financial firms listed on PSX over the period 2002 to 2012. The sample is composed of firms with complete available information. Moreover, firms that meet the following criteria are included in the sample:

- A firm is a non-financial firm.
- A firm does not have negative equities i.e. loss.
- A firm is not a state-owned firm.
- A firm has data available for the entire sample period.

Financial firms are excluded because using leverage does not mean the same for non-financial and financial firms. Firms with negative equities are excluded because such firms are presumably financially-distressed and their decisions are not normal. State-owned firms are not included as they have institutional backing in situation of poor performance or bankruptcy, which is a clear event of default in terms of agency theory whose effect cannot be truly captured on firm performance.

3.2. Model Specification

Following the work of Margaritis and Psillaki (2007), DEA is employed to develop an efficiency frontier of the efficient firms and to assess other firms compared to the frontier. This study employs two equation-based structural models which take reverse causality into account, as noted by Margaritis and Psillaki (2007), because capital structure and firm performance might affect each other. This also helps us in testing the two competing hypotheses; agency cost and efficiency (efficiency-risk and franchise-value) hypothesis. Additionally, performance is measured using profit efficiency as opposed to conventional indicators, by employing DEA which considers benchmarking of the firms and excludes the effects that are unrelated to agency costs.

The final model has the following form:

$$FE_{it} = \alpha_o + \alpha_1(LEV_{it}) + \alpha_2(SV_{it}) + \alpha_3(GROW_{it}) + \alpha_4(FSIZE_{it}) + \alpha_5(FAGE_{it}) + \alpha_6(BSIZE_{it}) + \alpha_7(BCOMP_{it}) + \alpha_8(DUAL_i) + \alpha_9(INST_{it}) + \alpha_{10}(MANG_{it}) + \alpha_{11}(CI_{it}) + \alpha_{12}(TA_{it}) + \alpha 13(DEit) + \varepsilon_{1it} \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$LEV_{it} = \beta_o + \beta_1(FE_{it}) + \beta_2(SV_{it}) + \beta_3(GROW_{it}) + \beta_4(FSIZE_{it}) + \beta_5(FAGE_{it}) + \beta_6(BSIZE_{it}) + \beta_7(BCOMP_{it}) + \beta_8(DUAL_i) + \beta_9(INST_{it}) + \beta_{10}(MANG_{it}) + \beta_{11}(CI_{it}) + \beta_{12}(TA_{it}) + \beta_{13}(PR_{it}) + \beta 14(Qit) + \varepsilon_{2it} \quad \ldots \quad \ldots \quad (2)$$

Where FE refers to the measure of firm efficiency (obtained through DEA), and LEV is the proportion of debt of the firm. The remaining variables are control variables

which are expected to affect the capital structure and firm performance while ε is an error term which is assumed to have zero mean and constant variance.

3.3. Benchmarking Firm Performance

There exist several methods to determine the firm performance. The most commonly used among them is financial ratio analysis. This method outweighs all other methods to evaluate firm performance in the empirical literature [Coelli, *et al*. (2005)]. Different types of ratios include liquidity, leverage, profitability, asset turnover and dividend ratios. However, there are also drawbacks of using such measures of firm performance. There are issues in implementing and assessing the managerial and firm performance, using ratio analysis [Avkiran and Rowlands (2008)]. It is difficult to evaluate the top performer of the industry and relative comparison of all other firms. So, a firm follows its competitors to decide where to operate with lack of any benchmark performance of the industry. Moreover, the macroeconomic factors such as inflation may affect the firm's balance sheet in which case the financial analysis using those figures needs precision. The financial ratios use absolute numbers with a little margin of error.

The DEA is considered more useful in measuring firm performance [Berger and Bonaccorsi di Patti (2006)]. It is a profit efficiency measure that controls for factors, such as market prices which are not in control of the management. Additionally, it is useful in giving efficiency scores for each single firm thus enabling a comparison among all firms. This method provides a benchmark that allows firms to set out their direction in terms of their operations. Profit efficiency i.e. (DEA method) is better than cost efficiency (i.e. SFA method) as far as agency theory is concerned, as it focuses particularly on the managers and their activities that how effectively they raise funds and minimise costs. Profit efficiency focuses on the maximisation of the firm value [Avkiran and Rowlands (2008)]. However, it differs from shareholders' value as part of the decline in the shareholders' value comes from rising agency cost affecting firm value. Profit efficiency is considered a better measure due to different interests of managers and shareholders. The measured profit of the best firm (using profit efficiency) acts as a standard for all other firms in the industry operating under the same conditions. This method considers the agency costs and inefficiency of the firms compared to efficient firms operating under the same conditions. The method gauges how distinct different firms operate from the best practice firms where a firm is considered as best practice only if the agency costs are minimised.

3.4. Data Envelopment Analysis (DEA)

DEA is a non-parametric analysis technique for measuring firm performance. It is used to assess the productive efficiency of the firms i.e. decision making units (DMU), which are assumed to be similar in terms of their operations as well as the operating environment. Efficiency is defined as the ratio of output to input [Farrel (1957)]. The greater the output, with a given level of input the greater the efficiency and vice-versa. It is termed as absolute or optimum efficiency. A firm is said to be technically efficient if the efficiency score equals 1. The difference in the efficiency scores is often because of the differences in technology or production process. A value of less than 1 refers to inefficiency which is then compared to potential production obtained through the analysis. The analysis can be done through statistical (i.e. econometric) and non-

statistical (i.e. programming). In the former, the output being the dependent variable (Y) is the result of some input(s) (X) along with the error term which represents the inefficiency. It is a parametric approach which assumes a functional form. In contrast, DEA uses input and output data on some variables of the DMU or firms to develop the efficient frontier that acts as a benchmark. It calculates the efficiency by taking into account the ratio of weighted outputs to inputs [Johnes (2006)].

It is a useful method as compared to financial ratios due to its capability to take several inputs and outputs for each DMU. This results in efficiency scores for each DMU which can take value from 0 to 1. This absolute unit of measurement makes it easy to compare different DMUs. Like other approaches and models, the DEA method requires no specification on part of inputs and outputs to get the efficiency scores and uses the traditional measures or firm information as inputs and outputs. The idea is to minimise the inputs with given level of outputs or maximise the outputs with given level of inputs. The DEA helps to identify good performance firms that become benchmark for others. This not only helps the management to know about the area of weakness which can be improved but also facilitates investors in their investment choice.

Using a concept of relative efficiency, the DEA allows a comparison of firms based on the best-performing firms in the group. The comparison and analysis are done by developing an efficiency frontier which includes all the best-performing firms at the top while other firms lie below it. The frontier, which is created using traditional ratios, is the actual benchmark for the poor-performing firms. They are said to achieve their potential output using given inputs in order to approach the efficiency frontier. Those poor-performing firms with good liquidity ratios are better enough to approach efficiency frontier. On the other hand, the debt ratios can lead firms far from the efficiency frontier. The efficiency scores obtained through DEA method are easy to interpret than traditional ratios as they bundle several inputs to give a point efficiency score.

In the efficiency analysis using DEA, Charnes, Cooper, and Rhodes (1978) established a scale which became the basis for assessing the efficiency of the firms with one another. The DEA efficiency analysis can be carried out using cost, scale, allocative and technical efficiency ([Coelli, *et al*. (2005)]. This study uses technical efficiency which refers to how well a company translates inputs into outputs. The technical efficiency can be split into pure technical (underutilisation of resources) or scale-size impact on DMUs. The technical efficiency is measured through Constant Return to Scale (CRS), i.e. the output increases with the same amount of input when all firms are operating at the same scale. While pure technical scale is measured through Variable Return to Scale (VRS), i.e. the output may not change proportionally with a given level of input [Banker, Charnes, and Cooper (1984)]. Due to the varied characteristics of the sample, this study uses VRS technology to measure technical efficiency. The financial performance can be measured using market and/or accounting-based data. Therefore, this study employs only accounting-based data which allows for assessing managerial performance considering agency theory [Margaritis and Psillaki (2007)]. Moreover, the scale efficiency is equal to technical efficiency divided by pure-technical.

The general equation for the DEA analysis has the following form:

DEA *ivars* = *ovars*, [*if*] [*in*] [, rts(crs | vrs | drs | nirs) ort(in | out) stage(1 | 2)] … … … … … … … (3)

where ivars and ovars refer to the input and output variables. Rts refers to return to scale i.e. constant returns to scale, variable return to scale, decreasing returns to scale and non-increasing return to scale. Ort refers to orientation i.e. input-oriented and output-oriented DEA. Stage refers to one-stage DEA and two-stage DEA.

Based on the discussion in the above paragraph, the equation for the DEA analysis, assuming VRS employed in this study has the following form:

$$\text{DEA } CAP\ COS\ CL\ OE = VA\ S\ E\ GP, \text{ rts(vrs) ort(out) stage(2)} \quad \ldots \quad (4)$$

where CAP is capital measured as firm's annual fixed tangible assets, COS is cost of sales for the period, CL is annual current liabilities and OE is annual operating expenses. VA is value-added, measured as product of shared price and outstanding shares less equity, S is annual sales, E is annual earnings and GP is gross profit for the period.

3.5. Measurement of the Variables

The variables used in this study along with symbol and measurement are presented in Table 3.1.

Table 3.1

Variable, Symbol and Proxy

Variable	Symbol	Proxy
Firm Leverage	LEV	Total Debt ÷ Total Assets
Firm Efficiency	FE	Efficiency scores via DEA Inputs: Capital (CAP), Cost of sales (COS), Current liabilities (CL), Operating expenses (OE) Outputs: Value-added (VA), Sales (S), Earnings (E), Gross profit (GP)
Firm Risk	SV	Standard deviation of earnings before tax
Growth Opportunities	GROW	Annual percentage change in the earnings
Firm Size	FSIZE	Logarithm of the firm's sales
Firm Age	FAGE	Number of operational years of the firm
Board Size	BSIZE	Logarithm of number of members on the board
Board Composition	BCOMP	Number of external members ÷ Total members
Chair Duality	DUAL	Dummy – 1 if CEO is Chairman, 0 otherwise
Institutional Ownership	INST	Shares owned by Institutions ÷ Total shares
Managerial Ownership	MANG	Shares owned by Managers ÷ Total shares
Market Power	CI	Firm sales ÷ Industry Sales
Asset Tangibility	TA	Proportion of net fixed assets to total assets
Profitability	PR	Earnings before interest & tax ÷ total assets
Instruments		
For Leverage (Debt/Equity)	DE	Total Debt ÷ Total Equity
For Efficiency (Tobin Q)	Q	(Book value of debt + Market value of equity) / Book value of assets

3.6. Testing for Endogeneity

Endogeneity refers to the problem when the econometric model includes an exogenous variable which is endogenous in nature and correlated with the error term [Semykina and Wooldridge (2010)]. According to Semykina and Wooldridge (2010), the OLS estimates of the parameters are not unbiased as long as the correlation of variable X and error term ε is not equal to zero. In this study, we use the test proposed by Hausman (1978) to check whether leverage and firm performance are jointly determined. In case if there is endogeneity problem then the OLS method yields biased estimates and a method known as two-stage least square (2SLS) will be used to get unbiased estimates of the parameters. The test assesses whether the estimates of OLS and 2SLS differ from one another and statistically significant. If the estimates differ then it can be inferred that the leverage and firm performance are endogenous. Based on the test results, we find that the appropriate model estimates are obtained using 2SLS method.

3.7. Marginal Effect for Efficiency and Leverage

The marginal effect (ME) of variable Y refers to its rate of change with respect to variable X. It is computed for a given variable by assuming that all other variables are held constant [Bartus (2005)]. In the linear regression model, the ME equals the relevant slope coefficient. The estimated marginal effect is the average of the ME at every data point. We use ME for observing the mean effects of firm efficiency and leverage. In addition, we also assess that how different variables affect firm efficiency at different levels of leverage and vice-versa.

4. RESULTS AND DISCUSSION

This section discusses the results concerning leverage and firm efficiency.

4.1. Descriptive Statistics

Table 4.1 provides the descriptive statistics of the sample firms. The mean leverage is 0.528 which shows that on average firms have employed more leverage than equity in their capital structures. The standard deviation of 0.19 indicates deviation of the firm leverage from the mean value. The minimum and maximum values for firm leverage are 0.03 and 0.97 respectively. Firm risk has a mean of 0.04, showing that the firm's earnings do not vary much across the sample with minimum and maximum value of 0.001 and 0.56 respectively. The mean for the firm growth is 0.247 with a standard deviation of 4.59. The statistic of firm risk and growth exhibits clustered earnings in terms of risk but varied earnings in terms of growth of the firms. The firm size has a mean of 7.97 with minimum and maximum of 4 and 12 respectively. The average of firm age is 32.4 with a large standard deviation of 16.3, confirming that age varies across the sample as both newer and older firms are included in the sample, while minimum and maximum age is 6 and 52 years, respectively. The board composition shows that on average only 0.257 of external members are on the boards. The dummy variable 'duality' shows that on average 0.221 of the CEOs also act as chairman of the board. Both the institutional and managerial ownerships have a mean value of 0.37 and 0.30, respectively. The average of 0.10 for market power confirms that firms have minimal power in the

market which can be regarded as almost competitive. Firms have 0.467 of the assets in the form of fixed tangible assets and 0.533 percent of current assets. The minimum for market power and asset tangibility is 0.00 with a maximum of 0.99 and 0.96 respectively. The firm's profitability is only 0.10, meaning 1 rupee of total assets generates on average 0.1 percent of earnings while minimum and maximum value is -0.44 and 0.49, respectively.

Table 4.1

Descriptive Statistics

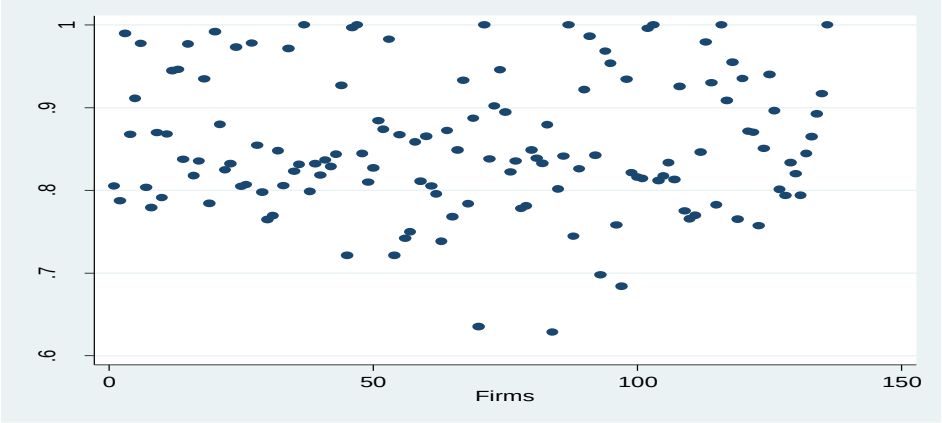
Variable	Mean	Median	Std.Dev.	Min	Max
Firm Leverage	0.528	0.548	0.194	0.030	0.978
Firm Risk	0.049	0.039	0.043	0.001	0.560
Firm Growth	0.247	0.071	4.590	-25.15	146.8
Firm Size	7.977	7.88	1.391	4.029	12.30
Firm Age	32.46	28	16.36	6	52
Board Size	2.074	2.07	0.178	1	3
Board Composition	0.257	0.143	0.287	0	0.929
Duality	0.221	0	0.415	0	1
Institutional Ownership	0.377	0.338	0.261	0	0.964
Managerial Ownership	0.307	0.244	0.285	0	0.967
Market Power	0.104	0.039	0.156	0.000	0.998
Asset Tangibility	0.467	0.477	0.198	0.001	0.965
Profitability	0.109	0.094	0.087	-0.445	0.493
CRS Technical Efficiency	0.822	0.813	0.093	0.473	1
VRS Technical Efficiency	0.855	0.850	0.097	0.051	1
Scale Efficiency	0.98	0.963	0.045	0.724	1

Table 4.1 also reports estimates of the mean firm efficiency. Both the efficiency estimates using CRS and VRS technology show almost similar mean efficiency score of 0.82 and 0.85 respectively. When CRS is assumed, it generates 0.47 of the minimum efficiency score while 0.05 in case of VRS. The maximum score is 1 for both the CRS and VRS. The scale efficiency being the ratio of CRS over VRS is 0.96 which is due to the increasing returns to scale as per estimates of the firms with minimum and maximum values of 0.72 and 1, respectively.

4.2. Efficiency by Firm

The efficiency measured through VRS technology of each firm is presented in Figure 4.1. It shows that seven firms can be termed as technically efficient among all the firms which constitutes the efficient frontier. All the remaining firms are inefficient considering the efficient frontier. The inefficient firms can improve, based on the slacks either to reduce the inputs with the given level of outputs or maximise the outputs with the given level of inputs.

Fig. 4.1. Firm by Efficiency



4.3. Correlation Analysis

Table 4.2 presents the correlation matrix. The association of FE with LEV, DUAL, MANG and TA is negative with LEV having the highest value of –0.50. It has a positive relationship with all other variables among which PR is strongly correlated followed by FSIZE. Similarly, LEV is positively related with BCOMP, DUAL, MANG while negatively with all others with PR being the highest. SV has a low negative correlation with FSIZE, FAGE, BSIZE, MANG, CI and TA and low positive correlation with all the remaining variables. Likewise, GROW also has a low correlation with all the variables with BSIZE, BCOMP, DUAL, INST and CI being negative. FSIZE is strongly correlated with CI and has a lowest positive and negative correlation with BCOMP and TA respectively. The same is true for FAGE which is negatively correlated with MANG and TA while positively correlated with all others. BSIZE and BCOMP have a low negative correlation with DUAL, MANG and TA. DUAL is positively correlated with MANG and TA while negatively correlated with others. INST is strongly negatively related to MANG and also to TA which is also negatively correlated with CI while both CI and PR have a negative correlation with MANG. PR is negatively associated with TA.

Table 4.2

Matrix of Correlation

	FE	LEV	SV	GROW	FSIZE	FAGE	BSIZE	BCOMP	DUAL	INST	MANG	CI	TA	PR
FE	1													
LEV	-0.50	1												
SV	0.10	-0.17	1											
GROW	0.06	-0.01	0.02	1										
FSIZE	0.42	-0.00	-0.10	0.01	1									
FAGE	0.18	-0.08	-0.03	0.01	0.24	1								
BSIZE	0.24	-0.01	-0.00	-0.02	0.34	0.10	1							
BCOMP	0.10	0.01	0.05	-0.01	0.02	0.05	0.19	1						
DUAL	-0.18	0.09	0.00	-0.01	-0.05	0.11	-0.12	-0.11	1					
INST	0.25	-0.18	0.03	-0.00	0.17	0.07	0.21	0.05	-0.14	1				
MANG	-0.29	0.16	-0.04	0.03	-0.24	-0.12	-0.22	-0.06	0.17	-0.71	1			
CI	0.36	-0.12	-0.05	-0.00	0.53	0.21	0.33	0.04	-0.12	0.17	-0.28	1		
TA	-0.37	-0.10	-0.02	0.02	-0.04	-0.19	-0.00	-0.07	0.08	-0.17	0.25	-0.05	1	
PR	0.63	-0.35	0.17	0.14	0.12	0.05	0.07	0.13	-0.11	0.10	-0.14	0.19	-0.26	1

4.4. Regression Results for Efficiency

Table 4.3 reports the results of the Sargan test for validity of the instruments used for the endogenous regressors. The p-value suggests that null hypothesis cannot be rejected and instruments are valid.

Table 4.3
Instruments Validity Test

Sargan test	1.323
Chi-sq(1) p-value	0.2501

Table 4.4 presents the estimates of the efficiency equation. The ***, **, * shows statistical significance at 1 percent, 5 percent, 10 percent levels respectively. The equation is estimated using 2SLS technique. The estimates are based on the VRS technology of the efficiency as the characteristics of the firms vary across sample such as age, size, tangibility of assets etc. Since there is a problem of endogeneity and errors are not i.i.d, the 2SLS is considered to provide efficient and unbiased estimates as it controls for the endogeneity along with robust estimates to correct for the error term.

The leverage has a significant positive impact on the efficiency. This result supports the *agency-cost hypothesis* that employing debt in the capital structure improves firm performance [Margaritis and Psillaki (2007); Zhang and Li (2007)]. The leverage is supposed to reduce the excess free cash flow, resulting in less agency costs and improved performance [Jensen (1986)]. Leverage also reduces the managerial opportunism which results in better firm performance [Warokka and Herrera (2011)]. Myers (2001) noted that leverage is also less costly and is coupled with reduced agency costs, which could have a positive impact on firm performance.

Risky firms are supposed to perform better than others. According to Florackis and Ozkan (2008), growth of the firm also enhances firm performance because of the disbursement of excess cash flow which reduces the free cash flow. The positive effect of size on efficiency suggests that bigger firms have improved performance. As mentioned by Titman and Wessels (1988), large firms have the ability to generate greater cash flows and acquire the least costly debt, backed by assets, resulting in less bankruptcy costs and better performance. Older and larger firms are expected to have a good reputation in the market with considerable market share [Hasan and Butt (2009)]. This is consistent with the findings of Hall, *et al*. (2004) in that the size and age of the firm determine the debt raised by a firm. Larger boards and external independent members on the board do contribute to firm performance. The variable of CEO duality has a statistically insignificant effect on firm performance. The existence of institutional investors does not improve efficiency while managers' stake in the firm also reduces firm performance. As mentioned by Shleifer and Vishny (1997), the institutions and large shareholders can exploit minority shareholder rights because minority may not have enough resources which can lead to a free rider problem. Firms with larger share of the market are supposed to exercise their power and influence the market, resulting in higher efficiency.

Table 4.4

Regression Results for Efficiency

Variables	2SLS
LEV	0.55***
	(0.17)
SV	0.25**
	(0.09)
GROW	0.001***
	(0.0005)
FSIZE	0.07***
	(0.01)
FAGE	0.003
	(0.002)
BSIZE	2.17***
	(0.49)
BCOMP	0.38***
	(0.14)
DUAL	0.48*
	(0.25)
INST	-0.32
	(0.50)
MANG	-1.80*
	(0.92)
CI	0.02
	(0.07)
TA	
Intercept	-4.54***
	(1.16)
Observations	1,392
R-squared	-0.057
Prob > F	0.000

The negative r-square indicates that the residual sum of squares is greater than the total sum of squares which can happen in 2SLS models; as instruments are used for the endogenous regressors to solve the structural model, while the r-square incorporates the actual values of the regressors which are different from those used to fit the model. The statistical significance of the individual coefficients is important which makes a good fit of the model.

4.5. Regression Results for Leverage

The test for validity of the instruments is presented in Table 4.5. The insignificant p-value does not allow the rejection of the null hypothesis of valid instruments.

Table 4.5

Instruments Validity Test

Sargan test	2.018
Chi-sq(1) p-value	0.1555

Table 4.6 presents the estimates for the leverage equation. The efficiency has a significant negative effect on leverage. It validates the *franchise-value hypothesis* that higher efficiency discourages the use of debt which can be used for protecting future gains. Higher efficiency as a result of higher earnings leads to higher retained earnings and lower debt ratio. Although higher efficiency increases firm's debt capacity but firms might not employ debt in the capital structure to avoid possible bankruptcy costs [Berger and Bonaccorsi di Patti (2006)].

Table 4.6

Regression Results for Leverage

Variables	2SLS
FE	–1.16***
	(0.08)
SV	-0.11
	(0.08)
GROW	0.0007
	(0.0006)
FSIZE	0.05***
	(0.01)
FAGE	–0.007***
	(0.001)
BSIZE	–0.60*
	(0.31)
BCOMP	–0.48***
	(0.07)
DUAL	0.62***
	(0.20)
INST	–1.36***
	(0.30)
MANG	–2.59***
	(0.68)
CI	0.01
	(0.07)
TA	–0.32***
	(0.03)
PR	
Intercept	3.57***
	(0.60)
Observations	1,392
R-squared	0.745
Prob > F	0.000

The same is true for risk that risky firms prefer equity over debt. Growth and market power positively affect leverage while risk and board size are statistically insignificant. Large, emerging and newer firms are expected to incur more debt than small and older firms. Board composition has a significant negative effect on leverage. Again, the institutional investors and managers cannot be the factors in determining debt. This is consistent with Warokka and Herrera (2011) that managerial ownership that leads to opportunism, being the cost of agency conflicts, may discourage leverage. Interestingly, the tangible assets do not help firms to raise debt. Based on the predictions of trade-off and agency cost theory, tangible assets are expected to be positively associated with leverage while pecking-order theory predicts a negative relationship. It also contrasts with Shah and Ilyas (2014), indicating a positive relationship between asset structure and leverage. Though, efficiency is negatively related to leverage which can cause firms to retain their assets for generating future gains.

4.6. Marginal Effects for Efficiency

Table 4.7 provides estimates of the mean effect of variables on efficiency of the firm. The findings are obtained from 2SLS method as employed earlier. These are the averages of the slopes for each variable with respect to the variable 'leverage'. The results suggest that on average, leverage is negatively associated with efficiency.

Table 4.7

Mean Effects for Efficiency

Variables	2SLS
LEV	–0.51***
	(0.13)
SV	0.29*
	(0.17)
GROW	–0.0004
	(0.001)
FSIZE	0.04***
	(0.008)
FAGE	–0.003***
	(0.001)
BSIZE	1.04***
	(0.20)
BCOMP	–0.10*
	(0.05)
DUAL	0.82***
	(0.12)
INST	–1.21***
	(0.24)
MANG	–3.07***
	(0.44)
CI	0.08
	(0.06)
Intercept	–0.76*
	(0.44)
Observations	1,392
R-squared	0.767
Prob > F	0.000

The same is true for growth, firm age, board composition and institutional and managerial ownership.[1] Greater risk helps firms to generate earnings. Firm size positively affects firm performance and is in line with the previous findings related to Pakistan [Latif, Bhatti, and Raheman (2017)]. The size factor is relevant with the view that larger firms do better than others in terms of survival while larger board size may ensure less exploitation of the resources due to monitoring of the independent members. As opposed to the view of agency theory, the CEO duality shows a positive relation with efficiency. As expected, market power enhances firm performance.

The regressions in Table 4.8 assess effects of different variables on firm efficiency at ten levels of leverage i.e. 0.05 for 1, 0.15 for 2, 0.25 for 3, 0.35 for 4, 0.45 for 5, 0.55 for 6, 0.65 for 7, 0.75 for 8, 0.85 for 9 and 0.95 for 10 with their respective p-values. Leverage ratio ranges from 0.05 to 0.95. The risk is statistically significant at levels 3, 4 and 5 and associated positively at low levels of leverage but negatively for highly levered firms. This may be caused by the additional risk taken to raise finance which increases the chances of financial distress resulting in poor performance.

Table 4.8

Marginal Effects for Efficiency

	SV		GROW		FSIZE	
_at	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
1	.2728	0.082	-.0002	0.881	.0465	0.000
2	.2337	0.059	.0001	0.932	.0509	0.000
3	.1947	0.035	.0004	0.606	.0553	0.000
4	.1556	0.016	.0007	0.158	.0597	0.000
5	.1165	0.012	.0011	0.007	.0640	0.000
6	.0774	0.123	.0014	0.011	.0684	0.000
7	.0384	0.598	.0018	0.043	.0728	0.000
8	-.0006	0.995	.0021	0.085	.0772	0.000
9	-.0397	0.768	.0024	0.123	.0816	0.000
10	-.0788	0.638	.0028	0.155	.0859	0.000
	FAGE		BSIZE		BCOMP	
_at	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
1	-.0036	0.000	1.0411	0.000	-.1055	0.072
2	-.0035	0.000	1.0379	0.000	-.1072	0.061
3	-.0033	0.000	1.0346	0.000	-.1089	0.053
4	-.0032	0.000	1.0314	0.000	-.1105	0.047
5	-.0031	0.001	1.0282	0.000	-.1122	0.043
6	-.0030	0.001	1.0249	0.000	-.1139	0.041
7	-.0028	0.002	1.0217	0.000	-.1156	0.041
8	-.0027	0.003	1.0184	0.000	-.1173	0.042
9	-.0026	0.005	1.0152	0.000	-.1190	0.044
10	-.0025	0.009	1.0119	0.000	-.1207	0.048
	INST		MANG		CI	
_at	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
1	-1.2131	0.000	-3.0725	0.000	.07557	0.190
2	-1.2076	0.000	-3.0687	0.000	.06500	0.210
3	-1.2022	0.000	-3.0649	0.000	.05443	0.250
4	-1.1967	0.000	-3.0611	0.000	.04386	0.324
5	-1.1912	0.000	-3.0573	0.000	.03329	0.446
6	-1.1858	0.000	-3.0535	0.000	.02272	0.614
7	-1.1803	0.000	-3.0498	0.000	.01214	0.802
8	-1.1748	0.000	-3.0460	0.000	.00157	0.976
9	-1.1694	0.000	-3.0422	0.000	-.00899	0.880
10	-1.1639	0.000	-3.0384	0.000	-.0195	0.768

[1]The extant literature generally shows that insider-ownership negatively affects firm performance (see for example, Ullah, Ali, and Mehmood (2017); Abdullah, Shah, and Khan (2012).

On the other hand, the growth variable is significant at levels 5, 6 and 7. Firm size and board size remain positive and significant at all levels except at level 1 for growth, while firm age, institutional and managerial ownership remain significant and negative at all levels. Similarly board composition also has a negative and significant effect at high levels of leverage. The effect of market power is also positive till level 8. The characteristics of the firm, as measured through the variables, allows inferring that highly levered firms generally show poor performance than low levered firms in the presence of the variables as discussed.

4.7. Marginal Effects for Leverage

The results for marginal effects of leverage regression are presented in Table 4.9.

Table 4.9

Mean Effects for Leverage

Variables	2SLS
FE	–1.91**
	(0.86)
SV	–1.00
	(0.82)
GROW	0.006
	(0.01)
FSIZE	0.08**
	(0.036)
FAGE	–0.009***
	(0.003)
BSIZE	–1.35***
	(0.45)
BCOMP	–0.65***
	(0.15)
DUAL	0.54**
	(0.22)
INST	–1.47***
	(0.40)
MANG	–2.18***
	(0.69)
CI	–0.98**
	(0.40)
TA	0.23
	(0.20)
Intercept	4.67***
	(0.90)
Observations	1,387
R-squared	0.753
Prob > F	0.000

The average efficiency has significantly negative effect while both risk and growth share an insignificantly negative and positive relationship with leverage, respectively. Large and newer firms seem to raise more debt financing while firms with large and diverse boards have low leverage. CEO duality positively affects leverage while institutional, managerial ownership and market power negatively affect it.

Slopes of the variables with respect to firm leverage at ten levels of efficiency are presented in Table 4.10. The levels are represented by value of 1 to 10 for 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95 and 1.00 of efficiency, respectively. The effect of risk and growth is positive and negative, respectively but insignificant for all firms including technically efficient firms. Firm size remains positive and significant while age, board size, composition, institutional and managerial ownership remain negative and significant at all levels of efficiency. Market power and asset tangibility also share negative relationships with leverage but share significant and insignificant at levels 1 and 2, respectively. Generally, more efficient firms do not attract higher leverage based on the relationship of the variables at levels of efficiency.

Table 4.10

Marginal Effects for Leverage

	SV		GROW		FSIZE	
_at	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
1	-.3960	0.222	.00317	0.502	.06744	0.000
2	-.3404	0.223	.00285	0.485	.06552	0.000
3	-.2848	0.227	.00253	0.462	.06360	0.000
4	-.2291	0.235	.00222	0.431	.06168	0.000
5	-.1735	0.255	.00190	0.385	.05976	0.000
6	-.1179	0.309	.00158	0.315	.05785	0.000
7	-.0622	0.483	.00127	0.205	.05593	0.000
8	-.0066	0.935	.00095	0.106	.05401	0.000
9	.04896	0.616	.00063	0.372	.05209	0.000
10	.10460	0.419	.00032	0.792	.05017	0.000
	FAGE		BSIZE		BCOMP	
_at	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
1	-.0086	0.000	-1.0124	0.002	-.5546	0.000
2	-.0085	0.000	-.98114	0.003	-.5457	0.000
3	-.0084	0.000	-.94988	0.003	-.5368	0.000
4	-.0084	0.000	-.91861	0.004	-.5279	0.000
5	-.0083	0.000	-.88734	0.005	-.5190	0.000
6	-.0082	0.000	-.85607	0.007	-.5101	0.000
7	-.0081	0.000	-.82480	0.010	-.5012	0.000
8	-.0081	0.000	-.79354	0.014	-.4923	0.000
9	-.0080	0.000	-.76227	0.020	-.4834	0.000
10	-.0079	0.000	-.73100	0.029	-.4745	0.000
	INST		MANG		CI	
_at	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
1	-1.4572	0.000	-2.3530	0.001	-.3906	0.036
2	-1.4560	0.000	-2.3684	0.000	-.3369	0.044
3	-1.4548	0.000	-2.3839	0.000	-.2833	0.057
4	-1.4536	0.000	-2.3993	0.000	-.2296	0.080
5	-1.4524	0.000	-2.4148	0.000	-.1759	0.123
6	-1.4512	0.000	-2.4302	0.000	-.1222	0.216
7	-1.4500	0.000	-2.4457	0.000	-.0686	0.424
8	-1.4488	0.000	-2.4611	0.000	-.0149	0.845
9	-1.4476	0.000	-2.4765	0.000	.0387	0.588
10	-1.4464	0.000	-2.4920	0.000	.0924	0.202

	TA	
_at	dy/dx	P>z
1	-.1004	0.246
2	-.1308	0.085
3	-.1611	0.014
4	-.1915	0.001
5	-.2219	0.000
6	-.2523	0.000
7	-.2826	0.000
8	-.3130	0.000
9	-.3434	0.000
10	-.3737	0.000

4.8. Robustness of Results

In order to reconcile the findings of the two models, namely agency cost and leverage, other variables instead of efficiency and leverage are used for robustness check. The proxy used for leverage is debt to equity. The results of the efficiency equation are given in Table 4.11. Leverage shows a significant positive relationship with efficiency. Although risk, firm age, board composition and market power have a negative relationship while growth, firm size, board size, duality, institutional and managerial ownership confirm the result of the agency cost model.

Table 4.11

Regression Results for Efficiency

Variables	2SLS
LEV	0.11**
	(0.05)
SV	–0.23
	(0.26)
GROW	0.0006
	(0.0009)
FSIZE	0.06*
	(0.03)
FAGE	–0.006
	(0.005)
BSIZE	0.87
	(0.55)
BCOMP	–0.12
	(0.17)
DUAL	1.03**
	(0.50)
INST	–1.15*
	(0.65)
MANG	–3.50**
	(1.67)
CI	–0.16
	(0.16)
TA	–
Intercept	–0.74
	(1.13)
Observations	1,392
R-squared	–7.377

A similar robustness check is performed for the leverage equation in Table 4.12. The proxy used for efficiency is Tobin Q. In contrast to the results of leverage model; the efficiency shows a positive association with leverage. The rationale behind this is that Tobin Q is a single measure used to assess firm performance, while the efficiency employed information on four inputs and four outputs as discussed earlier. In other words, DEA uses multiple inputs and outputs to assign weights based on the nature of data and measure efficiency. Growth, firm size, age, board size, composition confirms the results of the leverage model.

Table 4.12

Regression Results for Leverage

Variables	2SLS
FE	7.71
	(5.33)
SV	0.81
	(1.25)
GROW	0.01
	(0.01)
FSIZE	0.07
	(0.12)
FAGE	–0.003
	(0.01)
BSIZE	–6.68
	(4.44)
BCOMP	–0.28
	(0.60)
DUAL	–2.74
	(2.59)
INST	0.21
	(2.42)
MANG	14.33
	(11.72)
CI	–1.31
	(1.19)
TA	0.06
	(0.31)
PR	–
Intercept	10.51
	(6.75)
Observations	1,392
R-squared	–26.86

5. CONCLUSION

This study examined the endogenous determination of firm efficiency and leverage. It used DEA to measure the efficiency of the firm by establishing efficient frontier. The analysis was done using a panel data set of 136 non-financial firms listed on the PSX over the period 2002-2012. The data supported the fixed effect model instead of random effect. The leverage and efficiency were found to be endogenously determined. The empirical results obtained through 2SLS method supported *agency cost hypothesis* that leverage is related positively with efficiency. This finding is in line with existing evidence from Pakistan [Ullah and Shah (2014)]. The reverse causality from efficiency to leverage was also examined by considering *efficiency-risk* and *franchise value hypotheses*. The results confirmed the prediction of *franchise-value hypothesis* that efficiency shares a negative association with leverage. The earnings generated through higher efficiency increase the existing retained earnings resulting in lower debt ratio. Efficient firms try to protect their future gains through higher equity capital from possible liquidation [Berger and Bonaccorsi di Patti (2006)].

All the variables have a positive relationship with efficiency except institutional and managerial ownership. On the other hand, all the variables have a negative relationship with leverage except growth, firm size, CEO and market power. Generally, the findings of the study are quite robust.

The findings of this study are based on VRS technology due to varied characteristics of the sample firms. Researchers can consider making a different sample of firms with similar characteristics in terms of the variables included in this study such as assets, debt, size, age etc. The analysis can be carried out using CRS technology to examine how the variables affect firm financing and performance. Similarly, cross-industry comparison can be done to analyse the differences in results across each industry. External factors such as interest rate, technological changes and industry specific factors such as risk can also be considered in future studies. It is important to mention that the role of corporate governance is of utmost importance in corporate finance, especially in the studies of agency theory. So, it can be considered in the future studies, particularly the role of large investors in helping firms to resolve the principal-agent problems to improve firm performance.

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Sources to Finance Fiscal Deficit and Their Impact on Inflation: A Case Study of Pakistan

KASHIF ALI and MAHMOOD KHALID

Theoretically, fiscal deficit is inflationary but the sources of financing fiscal deficit may differ in terms of their impact on inflation. Question arises that what should be the least inflation cost source of financing? This study attempts to answer this question and explore the long run relationship among the sources to finance fiscal deficit and inflation. In so doing, the estimations have been done in four stages on the basis of categorisation of the deficit financing heads. In the first stage it has been tested that fiscal deficit along with money supply are inflationary. In the second stage fiscal deficit is bifurcated into two components, domestic borrowing and external borrowing for fiscal deficit. In the third stage, domestic borrowing is further divided into two heads, bank and non-bank borrowing. While in the fourth and last stage, bank borrowing is further categorised into two parts, borrowing from scheduled banks and central bank, and non-bank borrowing which comprises borrowing from National Saving Scheme for budgetary support. The Johansen Cointegration Technique is used for the first stage of estimation, while Auto Regressive Distributed Lag Model is employed for the rest of the three stages. The study finds that there is a long run relationship among sources of financing fiscal deficit and inflation. Inflation is positively affected by domestic borrowing, bank borrowing and borrowing from central bank, while central bank borrowing is more inflationary in nature. Consequently, fiscal deficit should be financed through external sources, non-bank and scheduled bank borrowings.

JEL Classification: H62, H74, E31
Keywords: Deficit, State and Local Borrowing, Inflation

1. INTRODUCTION

Borrowing at the government level may be good as well as bad for economic development of any country like any other business borrowing. It is beneficial for the economy as long as it is exercised with diligence and economic rationality. For governments, the debt becomes a problem if their debt servicing capacity does not grow with the increase in their level of indebtedness. In such situation borrowing adversely impacts the economy as governments tend to borrow more for debt servicing, a situation widely known as the Ponzi Games. Besides inflation, high interest rate and unstable exchange rate are some of the major problems that may arise from such kind of

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borrowings. While inflation is generally related to monetary expansion [Agha and Khan (2006)], it is generally argued that in developing countries fiscal imbalances might play a key role in generating inflation [Catao and Torrens (2005)]. As Sargent and Wallace (1981) pointed out that those governments who have persistent fiscal deficit have to finance with monetisation, causing high inflation in the long run.

Fiscal deficit is financed through various methods i.e. printing of money, using foreign reserves, borrowing from external sources, and borrowing domestically [Fischer and Easterly (1990)]. In Pakistan domestic borrowing comprises of bank borrowing and non-bank borrowings. Bank borrowing is further categorised as borrowing from State Bank of Pakistan (SBP) and borrowing from scheduled banks, while non-bank borrowing is mainly through National Saving Schemes (NSS) and others [SBP (2010)].

Along with the overall fiscal deficit, each mode of financing has its own disadvantages [Fischer and Easterly (1990)]. The government may choose to borrow from domestic sources. This would cause the interest rate to rise, which can lead to inflation by reduction in investment and shift in aggregate supply [Tullius (2007)]. Financing from scheduled banks may result in higher cost of lending to the private sector which may crowd out private investment and contribute to inflation. On the other hand, deficit financed from central bank directly by seignorage would create excess demand in the economy thereby causing inflation [Fischer and Easterly (1990)].

The restrictions imposed by the autonomous central bank on government borrowing facility from the banking system may compel the government not to borrow more from the banking sector [Feltenstein and Iwata (2002)].[1] This hard ceiling suggests that the government must search for other sources of financing. The government may borrow from external sources which will swell the current account deficit and depreciate the real exchange rate, causing price level to increase in the economy [Pasha and Ghaus (1996)]. Given its limited access to foreign borrowing; non-bank borrowing may become the other source of financing for the government. After getting funds from the two sources (domestic banking sector, including central banks and foreign sources), the rest of the funds may be raised by the non-bank borrowing [Feltenstein and Iwata (2002)], which in the case of Pakistan is mainly from the National Saving Schemes (NSS).

It is generally believed that non-bank borrowing has low inflationary impact, but it has adverse effect on domestic debt sustainability. In Pakistan, NSS borrowing is very costly due to high servicing cost associated with it, becoming as high as 18 percent in 1996-97. This high interest rate not only leads to decrease in the bank deposits, which not only deteriorates the banking sector services but also adds to the high debt servicing obligations of the government. Hence more money creation will be required for repayment, which will bring more inflation [Agha and Khan (2006)].

In Pakistan, there may be several factors of supply side as well as demand side being responsible for inflation. From supply side, prices of food items and oil are considered very much responsible for inflation. Prices of most consumer goods fluctuate with oil price swings. However, the role of food prices is statistically insignificant [Khan, *et al*. (2007)], therefore high inflation may mainly result from persistent fiscal deficit [Khan and Agha (2006); Sarfarz and Anwar (2009)].

[1]Although we found that there is no restriction on the government borrowings from central bank in Pakistan, in the act named as Fiscal Responsibility and Debt Limitation [FRDL (2005)], which is not strictly binding in Pakistan, is devoid of it [Qasim and Khalid (2012)].

The impact of borrowing on inflation varies by the source of borrowing i.e. borrowing from some sources will lead to inflation more than the other and the impact may vary in short term and long term. The question thus arise as to which source of financing the fiscal deficit is is less inflationary and thus optimal? This study attempts to answer this question empirically, by using the data from 1976 to 2014 of Pakistan. The analysis will help to identify economic cost through inflation associated with each type of borrowing so that government may choose such mode which would not hurt the economy severely in terms of higher inflation, besides looking at the accounting cost of borrowing.

The study is structured as follows. Section 2 presents a selected review of literature while Section 3 outlines the methodology and describes the data. Empirical findings are discussed in Section 4. Section 5 concludes with few policy suggestions.

2. SELECTED LITERATURE REVIEW

Starting from the classical debate, Sargent and Wallace (1981) questioned the statement of Friedman (1956) that inflation is always and everywhere a monetary phenomenon. They are of the view that inflation is a fiscal driven phenomenon because fiscal authority moves first and sets the budget independently about revenue generation through government bonds and seignorage. In such situation government will sooner or later monetise this budget deficit which will lead to inflation. But Leeper (1991) and Sims (1994) presented the idea of fiscal theory of price level (FTPL); strongly suggesting that inflation is a fiscal phenomenon. They put forward considerations that government deficit must be financed in a sustainable manner and inter temporal budget constraint should be adhered to. However FTPL is empirically tested for many countries with mixed results.

Different studies have been conducted to investigate the link between fiscal deficit and inflation. Developed economies show weak or no association between budget deficit and inflation.[2] While in developing economies, most of the studies show that there is a positive relationship between fiscal deficit and inflation in high inflation episodes [see Catao and Terrones (2005), Habibullah, *et al*. (2011) and Lin, *et al.* (2013)].[3] On the other hand, Koru and Özmen (2003) and Samimi (2011) established for Turkish and Iranian economies that no long run relationship between fiscal deficit and inflation holds. According to Catao and Terrones (2005) this may be because of selection bias, using wrong model specification and/or wrong econometric techniques. Once these limitations are addressed, the argument that fiscal deficit having inflationary impact is strongly supported.

The literature related to Pakistan also gives mix results. Kemal (2006), Malik (2006) and Qayyum (2006) found that inflation is a monetary phenomenon in Pakistan. But they ignored fiscal deficit as an important factor in the determination of inflation. Mukhtar and Zakaria (2010) included both money supply and fiscal deficit in their econometric modelling and found that inflation is a monetary phenomenon, while Shabbir and Ahmad (1994) reported that fiscal deficit is directly linked with inflation.

[2]See also King and Plosser (1985), Catao and Terrones (2005), Vieira (2000).

[3]See also Chaudhary and Parai (1991), Anoruo (2003), Lozano (2008), Sahan (2010), Metin (1998), Kia (2010), and Erkam and Çetinkaya (2014).

Agha and Khan (2006), using Johanson Cointegration technique, also found that changes in inflation do not take place only by the money supply but also by the fiscal deficit. This supports the argument that in Pakistan inflation may be a fiscal phenomenon. Mughal and Khan (2011) showed that inflation is granger caused by fiscal deficit in Pakistan. Similar results were found by Jalil and Bibi (2014) using panel ARDL model. The results are in line with Chaudhary and Ahmed (1995), suggesting that money supply is not exogenous rather it is endogenous. They found that money supply and deficit financing from domestic sources especially from banking sector positively affect inflation.

Agha and Khan (2006) found that inflation is positively influenced by the total domestic bank borrowings. The study concluded that if there is increase of 1 billion rupees in domestic bank borrowing for budgetary support, the prices would go up by 0.0048 percentage points. Sarfaraz and Anwar (2009) found a positive relationship between total domestic borrowings, including banking and non-banking borrowings for financing fiscal deficit. Furthermore, it is concluded that borrowing from international sources are also inflationary in nature.

The review of the relevant literature shows that while there are a number of studies which have analysed the role of monetary and fiscal policies in inflation, no study has been conducted on the relationship between the sources of the deficit finances (bank borrowings, borrowings from commercial banks, borrowings from central bank and non-bank borrowings for fiscal deficit financing) and inflation. Also, the existing literature does not provide any empirical evidence on how the composition of borrowing impacts inflation and which source is more inflationary than the other. So this study aims to fill this literature gap for Pakistan.

3. THEORETICAL BACKGROUND AND ESTIMATION METHOD

According to Catao and Torrens (2005) inflation(CPI_t) is a function of fiscal deficit (FD_t) and may be written as:

$$CPI_t = f(FD_t) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.1)$$

The above function shows that fiscal deficit is inflationary in nature. We have modified the function by extending it to incorporate the ways and means of financing fiscal deficit in Pakistan. Government can finance the deficit by making changes in money supply stock (dM_t); borrowing from domestic sources (dDB_t) as well as from external sources (dE_t), thus 3.1 can be written as follows:

$$CPI_t = f(dM_t, dDB_t, dE_t) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.2)$$

Domestic interest bearing debt can be further categorised as bank(BB_t) and non-bank borrowings (NBB_t). Therefore 3.2 may take the following functional form:

$$CPI_t = f(\mathrm{d}M_t, dBB_t, dNBB_t, dE_t) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.3)$$

Similarly the bank borrowings are decomposed into borrowing from scheduled banks (SBB_t) and state bank(CBB_t), while non-bank borrowing is equal to the debt comprised of national saving scheme (NSS_t), thus 3.3 becomes,

$$CPI_t = f(dM_t, dCBB_t, dSBB_t, dNSS_t, dE_t) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.4)$$

Equations (3.1), (3.2), (3.3) and (3.4) are estimated in four different stages. Data has been taken from *Pakistan Economic Survey* (various issues), Pakistan Bureau of Statistics and State Bank of Pakistan for the period of 1976 to 2014.

It is well known that most of the time series data follow a unit root process. So with the presence of unit root, simple regression analysis gives spurious results. If non-stationary data is converted into a stationary process, the results of regression analysis are only applicable for the short run analysis, while economists are generally interested in long run relationship. To solve this problem, Engle and Granger (1987), Stock and Watson (1988), Johansen cointegration technique (1988) and Autoregressive Distributed Lags (ARDL) can be used. This study uses Johansen's cointegration technique and ARDL method, as they are mostly used in the empirical work and are considered superior to others.

3.1. Data and Variables

This section discusses the data and construction of variables as follows:

3.1.1. *Consumer Price Index* (CPI_t)

In empirical analysis, CPI is the most commonly used gauge of the level of prices in an economy [Mankiw (2005)]. Therefore this study incorporates CPI as a measure of inflation.[4]

3.1.2. *Fiscal Deficit* (FD_t)

Budget deficit is the difference between total revenue and expenditure during a fiscal year. If BD_t is the budget deficit, SAB_t is the surplus of autonomous bodies and D_t is the discrepancy, then budget deficit can be converted into fiscal deficit (FD_t) as follows:

$$FD_t = BD_t + SAB_t - D_t$$

3.1.3. *Money Supply* ($M2_t$)

M2 is defined as the sum of currency in circulation, other deposits with State Bank of Pakistan, demand and time deposits, including resident foreign currency deposits with scheduled banks.

3.1.4. *Central Bank Borrowing for Budgetary Support* (CBB_t)

It is the government borrowing from State Bank of Pakistan directly for fiscal deficit financing through new money creation in the economy and/or borrowing through Ways and Means Advances.

3.1.5. *Scheduled Banks Borrowing for Budgetary Support* ($\boldsymbol{SBB_t}$)

It is the bank borrowing from all commercial banks and specialised banks.

3.1.6. *Bank Borrowing for Budgetary Support* ($\boldsymbol{BB_t}$)

Bank borrowing for budgetary support is the borrowing of a government from banking sector within the economy during a specific fiscal year.[5]

[4]CPI is broader measure than WPI and SPI, comparison is given in Appendix I.

[5]The Sum of Central bank borrowing and scheduled bank borrowing is called the Bank borrowing.

3.1.7. *Borrowing from National Saving Scheme for Budgetary Support* (NSS_t)

NSS funds are generated through different schemes, i.e. Certificates,[6] Accounts[7] and prize bonds by Central Directorate of National Saving (CDNS) under Ministry of Finance (MOF).

3.1.8. *Non-Bank Borrowing for Budgetary Support* (NBB_t)

Non-bank borrowing includes the funds through NSS and other bonds, issued through SBP to the individuals and other Non-Bank Financial Institutions (NBFIs).

3.1.9. *Domestic Borrowing for Budgetary Support (DB)*

It includes both bank and non-bank sources of financing.

3.1.10. *External Borrowing for Budgetary Support (EB)*

External borrowing for budgetary support is the fiscal deficit financing through external sources of financing, including governments and international financial agencies.

3.1.11. *Data Sources*

The data is collected from State Bank of Pakistan (SBP), Ministry of Finance (MOF) and Pakistan Bureau of Statistics (PBS).[8]

4. RESULTS AND DISCUSSION

Table 4.1 provides the summary statistics of the data.

Table 4.1

Descriptive Statistics of the Data

	Mean	Maximum	Minimum	Std. Dev.
CPI_t	55.61309	189.58	8.191269	49.46567
FD_t	295889.5	1833864	12480	448859.5
$M2_t$	1980858	9807088	46417.6	2605489
$RGDP_t$	5380594	10640381	1737139	2652184
DB_t	234023.3	1835540	5711	403825.4
EB_t	61866.18	511727	–5900	91618.01
BB_t	126627.3	1457500	–73811	281231.5
NBB_t	107396	553330	–515	152628.2
CBB_t	101.0794	688.724	–249.238	214.8509
SBB_t	136.6532	939.5683	–134.173	273.3708
NSS_t	169500.1	553330	8050	178180.8

[6](a)Defense Saving Certificates (DSC), (b) Special Saving Certificates Registered (SSCR), (c) Regular Income Certificates (RIC), Bahbood Saving Certificates (BSC).

[7](a) Saving Account (SA), (b) Special Saving Account (SSA), (c) Pensioner's Benefit Account (PBA).

[8]All of the Variables are taken as flow variables in the analysis. All are measured in Millions of Pak Rupees except CPI.

The starting point of the analysis of time series data is to test the stationarity of the given series used in the analysis. For this purpose, Augmented Dickey and Fuller (ADF) test was used. The results of the unit root tests are presented in the following table.

Table 4.2

Results of ADF Test

	Variables[9]	At Level	At First Difference	Conclusion
DEPENDENT VARIABLE	cpi_t	–2.688	–3.117*	I(1)
CONTROL VARIABLE	$m2_t$	–3.357	–4.511*	I(1)
	$rgdp_t$	–2.376	–3.681*	I(1)
STAGE 1	fd_t	–2.442	–5.304*	I(1)
STAGE 2	db_t	–2.448	9.479*	I(1)
	eb_t	–6.689*	–	I(0)
STAGE 3	bb_t[10]	–5.347*	–	I(0)
	nbb_t	–5.507*	–	I(0)
STAGE 4	cbb_t	–3.837*	–	I(0)
	sbb_t	–3.927*	–	I(0)
	nss_t	–2.303	–3.588*	I(1)

The tests show that variables that are used in the first stage of estimation are stationary at first difference whereas variables of the second, third and fourth stage estimations are of mixed order of integration, i.e. some are integrated of order zero and some are one.

4.1. First Stage Estimation

In the very first stage this study shows that fiscal deficit and inflation has a long run relationship. The specified model[11] is given below.

$$cpi_t = \alpha_1 + \beta_1 fd_t + \beta_2 m2_t + \beta_3 rgdp_t + \nu_t \quad \ldots \quad \ldots \quad \ldots \quad (4.1)$$

ν_t is a stochastic process. Both fiscal deficit (fd_t) and money supply ($m2_t$) are considered as endogenous variables while real gross domestic product ($rgdp_t$) is employed as a control variable. Table 4.2 indicates that all of the variables used in the first stage estimation are of I(1) for long run relationship, therefore Johansen cointegration technique is used.

Results of the Johansen cointegration technique are given in Table 4.2. After specifying the appropriate lag length of 2 lags, the Trace test indicates that two

[9] Small alphabets represent that variables are in log form.

[10] Unit root results are mentioned with trend and intercept in Level, except NBB, SBB and NSS, they have only intercept. There is no trend at first difference in all variables.

[11] Used by Agha and Khan (2006).

cointegrating vectors may exist in the system, whereas Maximum Eigen value test indicates only one cointegrating vector.

Table 4.3

Results of Johansen Cointegration Technique

Trace Test				
H_0	H_1	Trace Statistic	95% Critical Value	Probability
r = 0	r = 1	43.9145*	29.7971	0.0007
r = 1	r = 2	15.8346*	15.4947	0.0444
r = 2	r = 3	2.3965	3.8415	0.1216
Maximum Eigen Value Test				
H_0	H_1	Max-Eigen Statistic	95% Critical Value	Probability
r = 0	r ≥ 0	28.0800*	21.1316	0.0045
r = 1	r ≥ 1	13.4381	14.2646	0.0672
r = 2	r ≥ 2	2.3965	3.8415	0.1216

Note: *indicates rejection of null hypothesis at 5 percent level of significance.

According to Toda (1994) and Lutkipohl, *et al*. (2000) the trace test is size distorted; therefore we may conclude on the basis of Eigenvalue test statistic that there may be only one cointegrating vector.[12]

The estimated long run relationship is given below:

$$\widehat{cpi}_t = \underset{(0.02693)}{0.1665 fd_t} + \underset{(0.05152)}{0.6644 m2_t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.2)$$

[13]

Equation (4.2) shows that inflation is positively affected by money supply and fiscal deficit in the long run. The results are in line with Shabbir and Ahmad (1994), Agha and Khan (2006) and Jalil and Bibi (2014), while these are in contrast to Mukhtar and Zakaria (2010).

4.1.1. *Vector Error Correction Model*

In three variables case, VECM is given in the following equations.

$$\Delta cpi_t = \alpha_0 + \sum \alpha_i \Delta cpi_{t-i} + \sum \beta_i \Delta fd_{t-i} + \sum \gamma_i \Delta m2_{t-i} + \varphi_1 \mu_{t-1} + \varepsilon_{1t} \quad \ldots (4.3)$$

$$\Delta fd_t = \alpha_0 + \sum \alpha_i \Delta fd_{t-i} + \sum \beta_i \Delta cpi_{t-i} + \sum \gamma_i \Delta m2_{t-i} + \varphi_2 \mu_{t-1} + \varepsilon_{2t} \quad \ldots (4.4)$$

$$\Delta m2_t = \alpha_0 + \sum \alpha_i \Delta m2_{t-i} + \sum \beta_i \Delta fd_{t-i} + \sum \gamma_i \Delta cpi_{t-i} + \varphi_3 \mu_{t-1} + \varepsilon_{3t} \ldots (4.5)$$

[12]If Trace test is true and we have two cointegrating vectors, Qayyum (2005) argued that conventionally the first vector may be used as a long run equation; otherwise we have to use restricted VECM. First the system should be identified then VECM results can be interpreted.

[13]In parenthesis standard error of the corresponding coefficient is mentioned. Both fiscal deficit and inflation are statistically significant at 1 percent level of significance. Their corresponding *t*-value are *t*-calculated for fd= 6.18 while for m2 it is 12.9.

If $\varphi_k < 0$ and statistically significant then the cointegration relationship is confirmed between variables based on the underlying theory. VECM results are given in Table 4.4.

Table 4.4

Results of VECM[14]

	Coefficient	Std. Error	t-Statistic	Prob.
ECM_{t-1}	–0.4649	0.0973	–4.7794	0.0001
Δcpi_{t-1}	0.5383	0.1460	3.6873	0.0010
Δcpi_{t-2}	0.1088	0.1368	0.7953	0.4334
Δfd_{t-1}	–0.0567	0.0201	–2.8218	0.0088
Δfd_{t-2}	–0.0560	0.0195	–2.8677	0.0079
$\Delta m2_{t-1}$	0.0090	0.1170	0.0773	0.9389
$\Delta m2_{t-2}$	0.0784	0.1095	0.7153	0.4806
Constant	5.2013	1.1359	4.5791	0.0001
$rgdp_t$	–0.3347	0.0729	–4.5937	0.0001
R-squared	0.7317	$\chi^2{}_{auto}(2)$	0.4561	
Adjusted R-squared	0.6522	$\chi^2{}_{ARCH}(2)$	0.3402	
$\chi^2{}_{Normality}(2)$	0.5650			

$\chi^2{}_{auto}(2)$is the LM statistic of the autocorrelation test

$\chi^2{}_{Normality}(2)$is the LM statistic of the Jerque-Berra Normality test

$\chi^2{}_{ARCH}(2)$is the LM Statistic of the ARCH test.

Results of the VECM for Δcpi_t, as a dependent variable depict the short run dynamics. According to the above table, 46.5 percent of the disequilibrium in the short run will be corrected in the following year. The model qualifies all the diagnostic tests[15] i.e. autocorrelation, heteroscedasticity, normality and stability. On the basis of these results, we may therefore conclude that there is a long run relationship between fiscal deficit and inflation.

4.2. Second Stage Estimation

To estimate Equation (3.2) the econometric model may be treated as,

$$cpi_t = \alpha_2 + \beta_1 db_t + \beta_2 eb_{t}{}^{16} + \beta_3 m2_t + \beta_4 rgdp_t + \nu_{2t} \quad \ldots \quad \ldots \quad (4.6)$$

Where, db_t is domestic borrowing, eb_t is external borrowing and ν_{2t} is white noise. As access to foreign funds is limited, therefore most of the financing relies on the domestic borrowings. So domestic borrowing is considered as endogenous while external borrowing is partly exogenous, but for comparison purpose external borrowing is also considered as endogenous variable.[17]

[14]One cointegration equation is reported as per the convention in the presence of size-distorted trace test.

[15]The model is also checked for stability of the parameters by CUSUM and CUSUM-Square test. Parameters are stable in the system.

[16] As the stock of foreign debt is likely to be positively related to inflation but here we use foreign borrowing rather than foreign debt because of the following reasons: (1) we are interested in bifurcating the fiscal deficit, which is a flow variable, (2) the result remains almost the same even if we use the stock of foreign debt.

[17]As M2 carries both components, i.e. domestic borrowing and external borrowing, to avoid duplication in the data residual, part of the M2 should be used but due to data limitation we use M2 rather than the residual part of the M2.

4.2.1. *Results of Bound Test of Cointegration*

The existence of long run relationship is checked by conducting Bound test of cointegration. Results of the Bound test are given in Table 4.5.

Table 4.5

Results of Bound Test of Cointegration

Test Statistic	Value[18]	K
F-statistic	6.002	3
Critical Value Bounds		
Significance	I_0 Bound	I_1 Bound
10%	2.618	3.532
5%	3.164	4.194
1%	4.428	5.816

Note: Critical values are taken from Narayan (2005).

Even at 1 percent level of significance, F-statistic is greater than the critical bound; therefore the null hypothesis of no cointegration may be rejected. This allows us to establish the long run relationship between variables. The estimated long run relationship is expressed in Equation 4.7.

$$\widehat{cpi}_t = \underset{(2.486)}{4.539} + \underset{(0.026)}{0.055}db_t + \underset{(0.006)}{0.006}eb_t + \underset{(0.076)}{0.775}m2_t - \underset{(0.226)}{0.772}rgdp_t \quad \ldots \quad (4.7)$$

Equation (4.7) shows that domestic borrowing money supply along with real GDP contribute to inflation in the long run as their coefficients are highly significant;[19] while external borrowing is statistically insignificant. The reason of external borrowing to be statistically insignificant may be that whenever a government borrows from external sources, it does not put upward pressure on the money supply to monetise the borrowing. Therefore external borrowing is insignificant. So in comparison with domestic borrowing, external borrowing is less inflationary.[20]

To verify convergence from short run to long run equilibrium, the results of the ECM are given in Table 4.6.

Table 4.6

Results of ECM

	Coefficient	Std. Error	t-Statistic	Prob.
ECM_{t-1}	–0.337	0.071	–4.767	0.0000
Δcpi_{t-1}	0.509	0.131	3.895	0.0005
Δdb_t	0.019	0.009	2.051	0.0494
Δeb_t	0.002	0.002	0.986	0.3324
$\Delta m2_t$	–0.057	0.106	–0.541	0.5929
$\Delta rgdp_t$	–0.260	0.101	–2.569	0.0156
R-Square	0.9995	$\chi^2_{ARCH}(1)$		0.9597
Std. Error of Regression	0.0215	$\chi^2_{ARCH}(2)$		0.1469
$\chi^2_{auto}(1)$	0.7913	$\chi^2_{Norm}(2)$		0.8386
$\chi^2_{auto}(2)$	0.8938	$F_{RESET}(1,28)$		0.7853

Note: P-values of the LM test are reported for Diagnostic test.[21]

[18]The bound test also shows long run relationship at 1 percent, even by the critical bound generated by Pesaran, *et al*. (2001).

[19] Real GDP has negative relationship with inflation; results are same with Aysha, *et al*. (2013).

[20] Even if external borrowing is considered as exogenous, same results will be found.

[21] Both LM and F-statistics have asymptotically same distribution, while in small sample F is preferred [Pesaran and Pesaran (1997)] therefore only chi square probability values are reported.

$\chi^2_{auto}(.)$Represents LM statistic of BG test.
$\chi^2_{ARCH}(.)$ Indicates LM Statistic of ARCH test.
$\chi^2_{Norm}(2)$is thep-value of LM statistic of Jerque-Berra Normality test.
$F_{RESET}(1,28)$ is p-value of F-Statistic of Ramsey RESET.
Same notes are applicable for results of ARDL in the third and fourth stage of estimations too.

The negative and statistically significant error correction term (ECM_{t-1}) confirms the long run convergence. Adjustment in the error is quite good, almost 34 percent per year and the model is also a good fit as it qualifies all the diagnostic; therefore, we may conclude that there may be long run relationship of borrowing from domestic sources, external sources and money supply with inflation.[22]

4.3. Third Stage Estimation

As it has been confirmed from the second stage estimations that there is a long run relationship between borrowing from domestic sources and inflation. Next we test whether bank borrowing is more inflationary than non-bank borrowing. For this, Equation (3.3) can be written as:

$$cpi_t = \alpha_3 + \beta_1 bb_t + \beta_2 nbb_t + \beta_3 m2_t + \beta_4 eb_t + v_{3t} \quad \ldots \quad \ldots \quad (4.8)$$

Where bb_t represents domestic bank borrowing for financing fiscal imbalances, nbb_t is non-bank borrowing to finance fiscal deficit. $m2_t$ is money supply and eb_t is external borrowing. Except external borrowings all of the variables are considered as endogenous.[23]

4.3.1. *Results of Bound Test of Cointegration*

The results of the Bound test of cointegration is given in Table 4.7

Table 4.7

Bound Test of Cointegration

Test Statistic	Value	K
F-statistic	4.575	3
	Critical Value Bounds	
Significance	I_0 Bound	I_1 Bound
10%	2.618	3.532
5%	3.164	4.194
1%	4.428	5.816

Note: Critical values are taken from Narayan (2005) for 35 observations.

The null of no cointegration may not be accepted at 5 percent level of significance, as F-statistic (4.575) lies outside the upper bound (4.194). Therefore, long run relationship is concluded. The existence of long run relationship permits us to interpret

[22] VECM have same diagnostics as of ARDL, not mentioned in Table 4.6.

[23]Although there are restrictions on bank borrowing which makes it partly exogenous, but they are not in practice and for comparison purpose too, it is considered as endogenous.

Bank borrowing is the part of total money supply (m2) but correlation between them is just 23 percent. So it is expected that multicollinearity problem may not be there.

the long run relationship among the variables. The estimated relationship between inflation, non-bank and banking sectors, in the long run are given in Equation 4.9.

$$\widehat{cpi}_t = \underset{(0.0209)}{0.0354}bb_t - \underset{(0.0143)}{0.0088}nbb_t + \underset{(0.0197)}{0.5708}m2_t + \underset{(0.0115)}{0.0051}eb_t - \underset{(0.2501)}{4.0655} \quad \ldots \quad (4.9)$$

The long run estimates of the third stage analysis indicate that bank borrowing has positive impact on inflation at 10 percent level of significance, while non-bank borrowing decreases inflation. The non-bank borrowing is insignificant but has a negative sign. As quoted by Agha and Khan (2006), non-bank borrowing is theoretically non-inflationary in nature and historical context of the non-bank borrowing also shows negative association with inflation. In case of non-bank borrowing money goes in the hands of the government and aggregate demand remains the same causing no change in price level. So this may be the reason that non-bank borrowing is statistically insignificant, showing no impact on inflation. Another justification may be that borrowing from non-banking sector does not increase the monetary base, and hence does not contribute to inflation. Money supply plays an important role in determining inflation.

4.3.2. *The Error Correction Mechanism*

The ECM of the ARDL model shows short run fluctuations along with error correction. The results of the ECM is given in Table 4.8.

Table 4.8

Results of Error Correction Mechanism

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM_{t-1}	–0.1824	0.0568	–3.2123	0.0033
Δbb_t	0.0036	0.0021	1.7397	0.0929
Δnbb_t	–0.0016	0.0025	–0.6548	0.5179
$\Delta m2_t$	–0.2155	0.1312	–1.6423	0.1117
Δeb_t	0.0009	0.0021	0.4444	0.6602
Δcpi_{t-1}	0.5400	0.1327	4.0684	0.0003
R-Square	0.9993	$\chi^2{}_{ARCH}(1)$		0.4653
Std. Error of Regression	0.0229	$\chi^2{}_{ARCH}(2)$		0.3026
$\chi^2{}_{auto}(1)$	0.4969	$\chi^2{}_{Norm}(2)$		0.7077
$\chi^2{}_{auto}(2)$	0.6433	$F_{RESET}(1,27)$		0.2454

According to the short run analysis (Table 4.8) money supply and non-bank borrowing play no role in determining inflation, as they are statistically insignificant. The previous year's inflation plays a major role in determination of inflation in the short run. The reason may be that people expect more inflation in the next period, which may increase the demand for goods, increasing the price level in the economy. Correction in the error is 18.24 percent every year which is a bit low. This may be because of the insignificance of the major variables in the

model. However, on the basis of the analysis we can say that bank borrowing is inflationary in nature as compared to non-bank borrowing.

4.4.1. Fourth Stage Estimation

It has been confirmed that both bank and non-bank borrowing have long run relationship with inflation. To check which part of the bank borrowing and non-bank borrowing is inflationary, bank borrowing is further bifurcated into two components, central bank borrowing (CBB) and scheduled bank borrowing (SBB); while non-bank borrowing is comprised of National Saving Scheme (NSS), Pakistan Investment Bonds (PIBs) to individuals and other non-bank institutions. The privatisation proceeds are also included in non-bank borrowing, for budgetary support. But due to data limitations, NSS is calculated as non-bank borrowing minus privatisation proceeds.[24] In the same manner, central bank borrowing and scheduled bank borrowings are parts of broad money M2. So to avoid duplication, both CBB and SBB are subtracted from M2 and named as M2M.

In this stage we have tested which source of domestic financing of fiscal deficit is less inflationary, keeping external borrowing (EB) and M2 less CBB and SBB as exogenous, the following equation is tested:

$$cpi_t = \beta_1 cbb_t + \beta_2 sbb_t + \beta_3 nss_t + \beta_4 eb_t + \beta_5 m2m_t + v_{4t} \quad \ldots \quad \ldots (4.10)$$

Where v_{4t} is the white noise error term. Here cbb_t, sbb_t and nss_t are considered as endogenous while eb_t and $m2m_t$[25] are exogenously treated.

Since CBB and SBB data is available for 22 years only.[26] In such a small sample, to find the long run relationship, we are left with the choice of ARDL.[27] Narayan and Narayan (2005) used ARDL with 27 observations, and compared the computed bound test statistic with 30 observations critical bound given by Narayan (2005); while Pattichis (1999) used only 19 observations for ARDL and compared the bound test statistic with critical bound given by Pesaran, *et al.* (1996). These studies give some reliability to run ARDL with 22 observations, using the critical values used by Narayan (2005).

4.4.1. *Results of Bound Test of Cointegration*

The results of the bound test of cointegration are given in Table 4.9.

Table 4.9

Results of Bound Test of Cointegration

Test Statistic	Value	K
F-statistic	11.355	3

[24]As according to Agha and Khan (2006) and Ishrat Hussain (2007) non-bank borrowing is mostly comprised of NSS. Therefore it is assumed that NBB-Privatisation proceeds=NSS.

[25]M2 that part which is endogenously increased for fiscal deficit is removed from total m2. Therefore, only exogenous part is left.

[26]Thanks to Dr Mansoor Saleemi, SBP, who provided access to the data. Published data is only for 2001-14.

[27]In small sample ADF is biased while ARDL does not require pre-testing of unit root.

Critical Value Bounds		
Significance	I_0 Bound	I_1 Bound
10%	2.676	3.586
5%	3.272	4.306
1%	4.614	5.966

Note: Critical values are taken from Narayan (2005) for 30 observations

According to Table 4.9 there is a long run relationship among the said variables in the below equation, as the F-statistic lies outside the upper bound of the critical values.

$$\widehat{cpi}_t = -5.215 + 0.144cbb_t + 0.007sbb_t + 0.083nss_t + 0.007eb_t + 0.472m2m_t$$
$$(0.364) \quad (0.041) \quad (0.009) \quad (0.010) \quad (0.004) \quad (0.013)$$

This equation says that central bank borrowing (cbb_t), national saving schemes (nss_t) and exogenous money supply ($m2m_t$) contribute towards inflation, as they are statistically significant at 5 percent level of significance. In comparison, if significance is ignored, central bank borrowing is more inflationary than scheduled bank borrowing, as CBB has larger coefficient magnitude than SBB and NSS. Similarly NSS is more inflationary than SBB. So CBB is the most inflationary source of financing fiscal deficit in Pakistan

4.4.2. *The Error Correction Mechanism*

After confirmation of the long run relationship, the convergence to the long run mean is tested through ECM. The Results of the ECM is given in Table 4.9.

Table 4.10

Results of ECM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM_{t-1}	–0.522	0.088	–5.958	0.0001
Δcbb_t	0.041	0.018	2.256	0.0435
Δsbb_t	0.004	0.005	0.799	0.4399
Δnss_t	0.016	0.007	2.372	0.0353
Δeb_t	0.004	0.002	1.694	0.1161
$\Delta m2m_t$	0.247	0.043	5.780	0.0001
R-Square	0.9991	$F_{ARCH}(1)$		0.8248
Std. Error of Regression	0.1919	$F_{ARCH}(2)$		0.8371
$F_{auto}(1)$	0.9048	$\chi^2{}_{Norm}(2)$		0.4574
$F_{auto}(2)$	0.6583	$F_{RESET}(1,27)$		0.6072

There is negative and statistically significant ECM_{t-1} value which shows that long run convergence may take place if short run deviation occurs due to some unexpected shocks. Hence we may conclude that there is long run relationship respectively between borrowing from scheduled banks, central bank and National Saving Schemes with inflation.

5. CONCLUSION AND POLICY RECOMMENDATIONS

The basic aim of this study has been to find the least inflationary source of financing fiscal deficit and to analyse the long run relationship between sources to finance fiscal deficit and inflation. For this purpose fiscal deficit was divided into different sources, which are in practice in Pakistan for financing. Estimations were done in four stages depending upon the categorisation of the sources of financing fiscal deficit. On the basis of unit root results, two techniques were used, Johansen Cointegration Technique and Autoregressive Distributed Lag model. The results of the first stage show that there is a long run relationship between fiscal deficit and inflation along with money supply, which is the standard result in most of the studies. While the second stage results indicate that there is a long run relationship between domestic borrowing, external borrowing and inflation, but domestic borrowing is more inflationary than external borrowing, again a standard result. In the third stage of estimation, it is shown that bank borrowing and non-bank borrowing (parts of domestic borrowing) have long run relationship with inflation. In this case bank borrowing significantly contributes to inflation as compared to non-bank borrowing. So bank borrowing is more inflationary in nature than non-bank borrowing. In the fourth and last stage of estimation it is found that central bank borrowing, scheduled banks borrowings (part of bank borrowings), National Saving Scheme (part of non-bank borrowing) have inflationary effects in the long run, on inflation. Central bank borrowing is the most expensive source of financing as compared to scheduled banks and National Saving Schemes.

(1) The study recommends financing of the deficit through external borrowing and non-bank borrowing as these sources are found to be least inflationary. Further studies need to be conducted to explicitly focus on the supply side factors as well as on low and high inflation regimes which may have different implications for the source of deficit financing.

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Impact of Micro Hydropower Projects on Household Income, Expenditure and Diversification of Livelihood Strategies in Azad Jammu and Kashmir

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The study examines the impact of Micro Hydropower (MHP) projects on households' income, consumption and diversification of livelihood strategies in District Hattian Bala, Azad Jammu and Kashmir. A multinomial logistic model is used to investigate the possible role of MHP and other control variables on households' adoption of livelihood strategies. The Results show that MHP-micro hydropower has a positive significant effect on household's adoption of non-farm and diversified livelihood strategies. These findings suggest that MHP projects in Northern areas of Pakistan could help in improving household's income and consumption through adoption of high income livelihood strategies.

Keywords: Micro Hydropower (MHP), Livelihood Strategies, Income and Expenditures, Poverty Alleviation, Multinomial Logistic Model

1. INTRODUCTION

Energy is a prerequisite and vital part of agricultural, industrial and services sectors. It is a fundamental need of human life. Still, more than 1.6 billion people in different parts of the world are living without electricity [Greenstone (2014)]. Most of the developing economies have been using fossils fuel for their energy needs, which has damaged our environment and is considered the main cause of global warming and climate change. That is why in most of the economies, governments and international donors have initiated projects to produce renewable energy[1] for commercial and domestic uses. Renewable energy provides economic and social benefits with minimum human and environmental hazards. Sources of renewable energy include solar radiations, wind, biomass gases and hydropower, such as large freshwater reservoirs and micro hydropower units (MHP). Among renewable energies, hydropower energy is less costly and environment friendly; is an alternative to fossils fuel energy [REN21 (2010); Frey and Linke (2002)] and is produced by machines that are powered by moving water [Maier (2007)].

A number of countries[2] have highlighted the importance of MHP resources in national energy policies [Li, *et al.* (2009); Zhou, *et al.* (2009); Purohit (2008); Karki (2007); Yuksel (2007); Dudhani, *et al.* (2006); Benstead, *et al.* (1999)]. International

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[1]Renewable *energy* is collected from resources which are naturally replenished on a human timescale, such as water sunlight, wind, tides, waves, and geothermal heat.

[2] China, India, Turkey, Latin America and Caribbean.

energy and development policies, such as the Kyoto Protocol's Clean Development Mechanism (KPCDM), have designed incentives to encourage MHP development against fossils fuel energy and large freshwater reservoirs. In developing areas with growing demands for electricity, these policies are made with an aim to foster the development of renewable energy, along with the realisation of low carbon pollution and avoiding the undesirable social and environmental consequences, connected with large dams [REN21(2010); UNFCCC and CCNUCC (2006)]. In developing economies the benefits of MHP can be reaped at micro level, by fulfilling the energy requirements for small businesses development [Calderon (2005)] and creating employment opportunities in government and private sectors [Kirubi (2009); Rai (2000)]. It helps in increasing agricultural and livestock production, along with their processing and exports. In rural areas, MHP can meet the energy requirements for providing health, education and telecommunication services.

In Pakistan, about 64 percent of electricity is generated from thermal power while only 32 percent is generated from hydropower. Pakistan's Northern areas have huge potential for MHP production. Investment in MHP production can overcome the energy crisis and can help in reducing poverty as well [Umar, *et al.* (2015); Noor (2002)]. Currently, people in Northern areas are dependent on agriculture and they need additional sources of income to secure their wellbeing. Diversification of their livelihood strategies is only possible through development of non-farm sectors. The growth and development of non-farm sector in Northern areas is impossible without sufficient provision of electric power supply, and thus MHP production is the single best option. This study is designed to investigate the impact of MHP projects on rural households' livelihood diversification and increase in their income and consumption in Azad Jammu Kashmir (AJK). AJK has a potential of generating 8830.82 MW of electricity by using its freshwater resources, and government has launched a number of MHP projects with the objectives of socio-economic development and poverty alleviation [AJK at glance (2015)].

A number of studies have investigated the importance of MHP [eg Joshi (2011); Korkeakoski (2010); ADB (2010); Dhungel (2009); Sarala (2009); Sternberg (2008); ESMAP (2002)] however, only few studies have analysed its impact on livelihood diversification, income and expenditure of rural households in Pakistan [Saqib, *et al.* (2013); Noor (2002)]. This study aims to examine the impact of MHP projects on households' income and consumption in district Hattian, AJK; investigate the impact of MHP projects on diversification of households' livelihood strategies; and offer recommendations for improvement in household's welfare. The paper is divided into five sections. Section 2 provides a review of literature. Section 3 consists of methodology adopted for data collection and analysis. Section 4 presents results from data analysis. Section 5 spells outs conclusions.

2. REVIEW OF LITERATURE

A sizeable literature is available on the contribution of MHP to productivity and economic growth. Dhungel (2009) concluded that MHP can be a highly effective means to increase the economic welfare of the people in rural areas of Nepal. Paish (2002) highlighted the importance of MHP for long term income generating activities in Nepal. He found that most of the activities that were mechanical, such as milling, grinding and

rice processing, were easily performed through small MHP projects. This enhanced the livelihood opportunities and provided services for the welfare of community. MHP is one of the most cost-effective energy technologies for rural electrification in developing countries, thus supporting rural livelihoods [Paish (2002)].

In a study of small hydropower projects in rural areas of Laos, Korkeakoski (2010) highlighted that modern, safe and affordable energy from hydropower has a great potential to reduce poverty and to support the livelihoods of local communities. In a study by ESMAP (2002), a number of countries were analysed, using data from household surveys to find correlations between electrification and the increase in number of small business activities. It was found that households in electrified areas were more probable to run home businesses as compared to households in non-electrified areas. Cockburn (2005) studied the benefits of MHP in the development of home level textile production, grocery shops, workshops and other businesses in Tamborapa Pueblo. It was found that textile producers had more opportunities to deliver and trade in close urban communities, before the hydropower development. Additionally, the bakeries in the locality had been equipped to make more products, which they had been previously importing from other towns. Thus, this socio-economic progress made the area more appealing for future development.

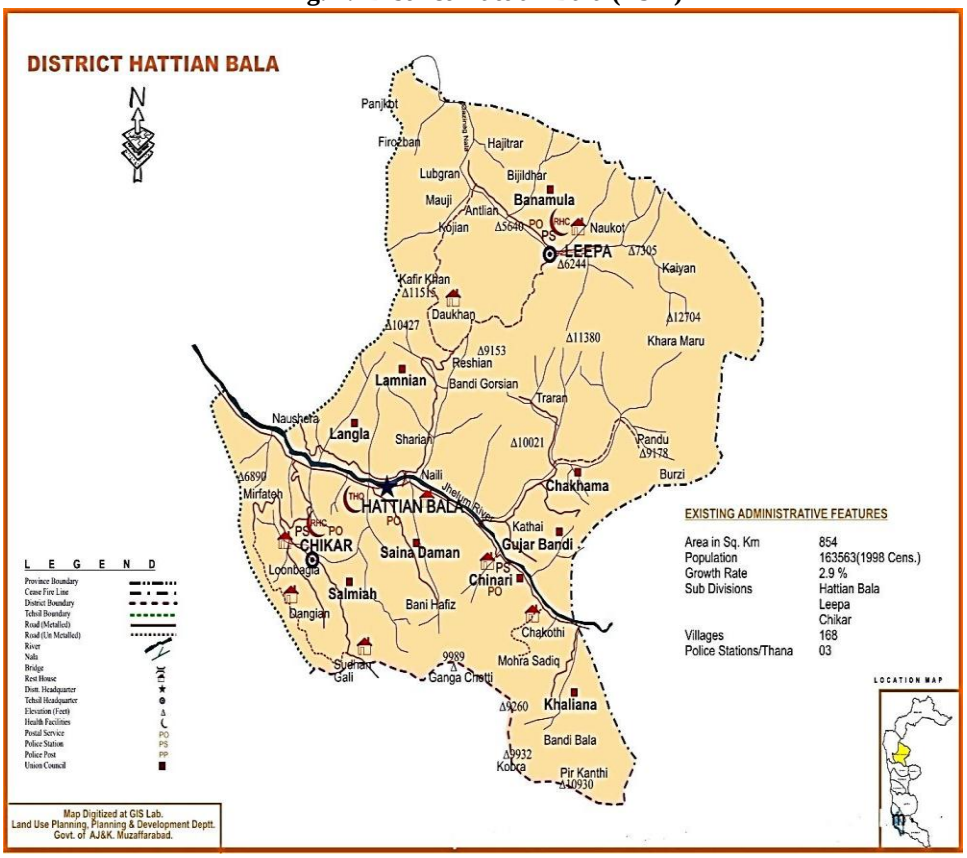
Noor (2002) examined the impact of MHP projects, installed by Aga Khan Rural Support Program (AKRSP), on the local communities in district Chitral of Pakistan. He found several social and economic benefits of MHP for local people. Due to electrical power supply, quality of life improved at a household level. Saqib, *et al.* (2013) conducted research on the impact of micro hydropower project on jobs creation in district Mardan of Khyber Pakhtunkhwa province. The study found that MHP project created a number of direct and indirect jobs. They also found increase in households' income that was attributed to diversification of livelihood strategies in MHP project area. A study conducted by Asian Development Bank [ADB (2010)] in Bhutan found a positive effect of electrification on households' income. The livelihood strategies of the electrified households were found more diversified and their incomes were 50-72 percent higher than those of un-electrified households.

3. METHODOLOGY

3.1. Study Area

District Hattian is located in AJK under the geographic limit of 34.1686 degrees North Latitude and 73.7934 degrees East Longitude. In the Northwest of the district, Neelum district is located, whereas in the West and South, Muzaffarabad and Bagh districts are situated. The total area of the district is 854 square kilometres, and total human population is 163563, having a growth rate of 3.6 percent (Census report 1998). The district is blessed with beautiful valleys and most of them are drained by Jehlum River and its tributaries. Jehlum River flows from Chakoti in the East to Naushera in the Northwest (see Figure 1). In sub valleys where altitudinal variations are high, electricity can be generated through MHP stations on fast flowing streams. Some MHP stations are working in Kathai, Leepa and Sharian areas. These areas and others, having potential for MHP are located on the upper northern side of the Jehlum River.

Fig. 1. District Hattian Bala (AJK)



3.2. Sampling and Data Collection

A multistage sampling technique was used to select a sample of 346 households. District Hattian consists of 12 union councils and 168 villages. Four union councils, Sharian, leepa, Kathai and Hattian were selected purposively. Sharian, Leepa, Kathai were electrified through MHP, whereas Hattian was electrified through national grid. From each of the three union councils, electrified through local MHP stations, two villages were randomly selected. Four villages were selected randomly from union council Hattian. Details on total number of households for selected villages were collected from the Revenue office of the district and State Earthquake Reconstruction and Rehabilitation Authority. Those details were used as sampling frame to decide about sample size and number of households from each village, using Sekaran's sampling table [Sekaran (2003)] and proportional allocation sampling technique. Lists of selected villages and number of sampled households from each village are given in Table 1. Simple random sampling technique was used to select the required number of households from each village.

Data was collected at household level, through face to face interview with the head of the household. A well-designed questionnaire was used to collect the required information from selected households.

Table 1

Distribution of the Sampled Respondents in the Study Area

	Union Councils	Villages	Total Households	Sampled Households
Villages Connected to Small Hydropower Projects	Langla	Sharian	290	32
		Gohraabad	250	28
	Gujar bandi	Kathai	260	29
		Ghrthama	305	34
	Leepa	Leepa	436	49
		Nakot	256	29
Villages Not Connected to Small Hydropower Projects	Hattian Bala	Saran	346	39
		Chathea	336	38
		Kaneena	250	28
		Dhanni	355	40
		Total	3084	346

Sources: Hydroelectric Board, District Muzaffarabad and Revenue Dptt., District Hattian (2015).

3.3. Analytical Tools

3.3.1. *Independent Sample t-test*

An independent sample *t*-test was used to examine the impact of MHP on households' income and expenditures. Sampled households were divided into beneficiaries and non-beneficiaries of MHP, and data on their income or consumption expenditures was used to calculate *t*-statistic value, using the following formula. Then, the probability of getting the calculated *t*-statistic value (p-value) was derived from *t*-table. The p-value shows significant difference for that indicator across beneficiaries and non-beneficiaries of MHP.

$$t = \frac{\left(\bar{X}_1 - \bar{X}_2\right)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$d.f. = \frac{\left(s_1^2/n_1 + s_2^2/n_2\right)^2}{\left(s_1^2/n_1\right)^2/(n_1-1) + \left(s_2^2/n_2\right)^2/(n_2-1)} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where t is *t*-statistic; n_1 and n_2 are number of households in sub sample beneficiary and non-beneficiary, respectively; $\bar{X}_1$ and $\bar{X}_2$ are mean income or expenditures of the beneficiary and non-beneficiary; and S_1^2 and S_2^2 are the unbiased estimator of the variance for sub sample beneficiary and non-beneficiary.

3.3.2. *Multinomial Logistic Model*

Following Gecho, *et al*. (2014), a multinomial logistic model (MLM) was used to estimate household's probability of choosing a livelihood strategy. MLM is a powerful tool that makes it possible to analyse factors influencing household's choice of a livelihood strategy in the context of multiple choices.

Based on different livelihood strategies, adopted by the sampled households, MLM was designed to estimate household's probability of choosing a livelihood strategy. Furthermore, to examine the possible role of MHP projects on household's adoption of a livelihood strategy, a dummy variable was added with other important variables (control variables) in the model.

MLM can be specified as follows;

$$P_r(y_i = j) = \frac{e^{x_i B_j}}{1 + \sum_{j=1}^{j=4} e^{x_i B_j}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Where

i (1, 2, 3,…..., 346) is *i*th households;
j (1,2,3,4) is *j*th livelihood strategy;
P_{ij} is the probability of *i*th household for choosing *j*th livelihood strategy;
X is a vector of variables affecting probability of choosing a livelihood strategy;
e is the natural base of logarithms; and
β*s* are weights or coefficients of *X* variables.

In fitting such a model, *J*-1 set of regression coefficients are estimated using maximum likelihood estimation method (MLE). The marginal effects (ME_i) of a variable *Xi* on the probability of choosing *j*th livelihood strategy is specified as

$$ME_i = \frac{\partial_{p_{ij}}}{\partial_{x_i}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

4. RESULTS AND DISCUSSION

4.1. Socio-economic Characteristics

Traditionally, most households in Pakistani culture are headed by male; particularly the senior male member holds command and control of most of the material resources of a family. Table 2 shows that 87 percent of the sampled households are headed by male and only 13 percent are headed by female. On average they are 44 years old and are educated up to 8 years of schooling. The same table shows that average household size is 7 individuals and their average monthly income is Rs 25327. They practice agriculture, non-farm and off-farm activities as their primary[3] sources of income generating livelihood strategies. Some farmers are engaged in diverse activities as livelihood strategies.

Agricultural activities included both crop production and animal husbandry. In the study area some of the major crops grown are maize, wheat and rice. Livestock products which are valuable in the area are milk products like butter, yoghurt. Off-farm activities are agricultural activities which take place outside the person's own farm. These

[3]In rural communities, households engage in more than one livelihood activity at a time [Ellis, *et al.* (2003); Bryceson (2000)]. The primary livelihood activity of the household is defined as the activity that generates the highest proportion of the household's overall income.

activities include local daily labour work at village level or the neighbouring areas, in return for cash payment or the agricultural work at another person's farm in return for part of the harvest in kind. Natural resource based activities like firewood collection for own consumption or for sale were other non-farm activities in this study. Non-farm activities include government services, business, handicraft activities (weaving, spinning, carpentry, remittance, etc.), petty trade (grain trade, fruits and vegetables trade) and trading of small cattle. Survey data on income generating sources show that 63 percent of the households have adopted non-farm livelihood strategy (NFLS), 15 percent have adopted agricultural livelihood strategy (ALS) and 11 percent are engaged in off-farm livelihood strategy (OFLS) and diversified livelihood strategy (DLS). Table 2 lists these livelihood strategies and the amount of average monthly income, generated by each strategy.

Average monthly income per household, generated from DLS and NFLS is significantly higher than NFLS and ALS. Conventional and marginalised farming could be the possible reasons for low income from agriculture and off-farm activities. In the study area open plain fields are limited and average land holding per household is 1.76 acres. Low income, smaller farm size and irregular topography cannot support the modernised intensive agricultural practices.

Table 2

Socioeconomic Characteristics of the Sampled Households

Variable	Mean Value	Standard Deviation
1. Head Characteristics		
1.1. Gender (1 for male otherwise 0)	0.87	0.33
1.2. Age(years)	44.68	10.97
1.3. Education(years of schooling)	8.33	4.53
2. Households Characteristics		
2.1. Size	7.00	2.67
2.2. Total monthly income (Pak. Rs.)	25326.88	11502.66
2.3. Income of households involved in		
a. Agriculture only (15 %)	12615.38	5375.70
b. Non-farm activities (63%)	27595.87	10694.05
c. Off-farm activities (11%)	18121.62	6256.42
d. DLS[1] (11%)	38284.62	9057.87
2.4. Landholding size(acres)	1.76	0.77

Source: Sampled Survey Data (2015).

4.2. Impact of MHP on Household's Income

The survey data show that the average monthly income of beneficiaries and non-beneficiaries is Rs 27703 and Rs 22033 respectively (Table 3). The average income of beneficiaries is greater than average income of non-beneficiaries by Rs 5067. Similarly, the average consumption expenditure of beneficiaries and non-beneficiaries is Rs 26166 and Rs 20861 respectively. Average consumption expenditure of beneficiaries is greater than average consumption expenditure of non-beneficiaries by Rs 5305. Table 2 provides results for the independent sampled *t*-tests. It is shown that beneficiaries' monthly income

and consumption expenditures are significantly greater than income and consumption expenditures of non-beneficiaries. These results reveal that in the study area MHP projects have positive and significant impact on household's welfare.

These results reveal that in the study area, MHP projects have a positive and significant impact on household income and consumption expenditure. One of the reasons is that the use of MHP electricity was cheaper than the cost of kerosene and gas cylinders so the respondents were able to save money from unproductive expenditure. Furthermore the total cost of small hydropower energy was less than per unit cost of energy from national grid. The increase in income was found in those households that were using MHP energy for business and other livelihood activities. Anup and Ian (2009) in Nepal and Kirubi (2009), in Kenya also found that the MPHs improved family income significantly.

Table 3

Income and Expenditures across Beneficiaries and Non-beneficiaries of MHP

	Beneficiaries	Non-beneficiaries	T-test (p-value)
Monthly Income	Rs.27703	Rs.22033	2.29 (0.00)
Monthly Cons. Expenditures	Rs.26166	Rs.20861	4.80 (0.00)

Source: Survey Data 2015.

4.3. Determinants of Choosing a Livelihood Strategy

To identify important determinants of households' choice of a livelihood strategy, factors such as the MHP and households socioeconomic characteristics were used as explanatory variables in MLM. Statistical analytical software STATA was used to estimate the parameters of the model. Agriculture livelihood strategy is used as a base category[4] in the coefficient of the variables. The likelihood ratio test statistics, indicated by the chi-square statistics (given in Table 4), is highly significant (p-value= 0.00) suggesting strong explanatory power of the model. The predicted probabilities[5] for choosing agriculture livelihood strategy (ALS), nonfarm livelihood strategy (NFLS), off farm livelihood strategy (OFLS) and diversified livelihood strategy (DLS) are 0.15, 0.63, 0.11 and 0.11 respectively.

The estimated model was tested for multicolinearity,[6] and the test failed to detect the problem. Moreover, the model was tested for the validity of the independence of the irrelevant alternatives[7] (IIA) assumption, using Hausman test for IIA. The test failed to

[4]STATA use maximum likelihood estimation (MLE) method for estimation of the parameters in MLM. It takes one of the livelihood strategies as a base category and report results for the others. Coefficients for each explanatory variable are estimated in reference to its effect for the base category. For this study, agriculture was taken as a base category because it is the primary sector of the district economy.

[5]Theoretically, the estimated mean values (probabilities) for dependent variable(s) from regression analysis must be equal to the actual mean values (probabilities).

[6]Correlation matrix was used to estimate for explanatory variables used in MLM to check for multicollinearity. The estimated correlation values suggest that the estimated model have no multicollinearity problem.

[7]IIA test is required for finalising categories of dependent variable for final multinomial regression analysis. Detection and utilisation of remedial measure for multicollinearity helps in reducing possibility of type 1 error

Table 4

MLE Results for Multinomial Logistic Model

Determinants	NFLS			OFLS			DLS		
	Coef.	t value	ME	Coef.	t value	ME	Coef.	t value	ME
MHP	4.27	5.11	0.30	1.20	1.49	–0.13	3.48	3.1	0.00
Age of the head									
40 to50 years	0.47	0.65	0.06	–0.75	–0.92	–0.06	0.28	0.22	0.00
Above 50 years	4.02	3.63	0.05	3.95	3.47	0.07	5.24	3.69	0.05
Education level									
5 to8 years	3.11	3.19	0.37	0.90	0.82	–0.08	1.33	0.91	–0.03
9 to10 years	2.60	3.42	0.24	1.16	1.41	–0.06	3.29	2.65	0.05
11t012 years	5.97	5.53	0.41	3.25	2.92	–0.10	6.73	4.50	0.07
>12 years	5.60	5.58	0.39	3.21	3.08	–0.08	6.39	4.41	0.07
Gender[1]	–1.38	–1.83	–0.91	17.73	0.01	1.35	–0.19	–0.12	0.15
Household size	–3.9	–4.06	–0.35	–1.75	–1.77	0.05	14.21	0.02	0.15
Landholding[2]									
Medium	–1.79	–2.78	–0.18	–0.34	–0.45	0.08	–0.59	–0.42	0.01
Large	18.11	0.01	–0.20	17.91	0.01	–0.03	23.04	0.01	0.36
Foreign Remit.	2.26	2.20	–0.19	0.52	0.37	–0.07	1.06	0.67	–0.03
Constant	–0.61	–0.87		–19.00	–0.01		–24.08	–0.03	

LLR chi^2 value: 400.48 (p-value=0.00).

$P_{(ALS)}$ =0.15 , $P_{(NFLS)}$ =0.63, $P_{(OFLS)}$ =0.11, $P_{(DLS)}$ =0.11.

(1) Gender of the head is a dummy variable (1 if male otherwise 0).

(2) In the study area average land holding is 1.76 acres and based on the distribution of land holding agricultural farms, are categorised into;

(i) Small farms (<1 acres).

(ii) Medium farms (1 to 2 acres).

(iii) Large farms (>2 acres).

(iv) Marginal Effects (ME).

reject the null hypothesis of independence of the livelihood strategy options, suggesting that the MLM specification is appropriate to model household's adoption of a livelihood strategy.

The estimated coefficient for explanatory variables, their z-statistics and marginal effect values are given in Table 4. Estimated model shows that MHP, age and education level of the household head are important and consistent determinants of household's choice of a livelihood strategy. The effects of other variables are inconsistent.

4.3.1. *Micro Hydropower (MHP)*

Electricity and water supply are the most important assets [Ellis (2000)]. In general, access to these assets has an important impact on the choice of livelihood strategy. Thus MHP is used as a dummy variable (1 for beneficiaries and 0 for non-beneficiaries), with the expectation of having a positive significant impact on the adoption of high income generating DLS and NFLS.

MHP has positive significant coefficients for NFLS and DLS. This signifies a positive impact of MHP on households' choice of NFLS and DLS over ALS. The

marginal effect value for MHP is 0.30 for NFLS,s which shows that beneficiaries of MHP are 30 percent more likely to choose NFLS over ALS as compared to non-beneficiaries. The marginal effect of MHP on probability of adopting the DLS is 0.10. These results indicate that beneficiaries of MHP have adopted the NFLS and DLS. As the income for these two categories is greater than income from NFLS and ALS (see Table 4), we can say that households are better off with MHP projects.

4.3.2. *Age of the Head*

In rural areas, livelihood decisions are generally taken by the household head. That is why the age of the household head is used as explanatory variable in the following three categorical forms: (1) Households headed by individuals below 40 years of age; (2) Households headed by 40-50 years old individuals; and (3) Households headed by individuals older than 50 years. The table shows that the 3rd age category has positive significant coefficients. These indicate a positive relationship between age of the household head and choice of DLS, NFLS and OFLS over ALS. Agricultural activities, such as land preparation, plantation, weeding and harvesting are labour intensive. The geophysical characteristics of the study area and households' weak economic conditions do not support mechanised agricultural practices. Older individuals are physically unfit to perform labour intensive agricultural activities and are likely to choose other livelihood strategies.

4.3.3. *Educational Level of the Household Head*

Educational level of the household head is expected to have a positive impact on household adoption of NFLS and DLS. An educated head can easily get job for himself and other members of his family in non-farm sector. The following 5 dummy variables for educational level of the head are used in the model: 0-4 years, 5-8 years, 9-10 years, 11-12 years and 13 plus years. Results indicate that education is highly important determinant of households' choice of other livelihood strategies over ALS. The coefficient values for the last two educational levels are consistently positive and statistically significant at 1 percent level of significance. The marginal effect values for education levels are very high for NFLS as compared to DLS and OFLS. These results indicate that a household headed by an educated member is likely to choose NFLS.

4.3.4. *Gender*

Gender influences diversification choices including, the variety of income-generating activities due to ethnically defined roles, social mobility restrictions and discrepancy in possession of access to assets [Ishaq and Memon (2016); Galab, *et al*. (2002)]. In our model gender is used as a dummy variable (1 for male headed households and 0 for female headed households). The estimated coefficient for NFLS is negative and statistically significant. This indicates that female headed households are more likely to choose NFLS over agricultural livelihood strategy (ALS). The marginal effect of gender is –0.91. It means that holding other factors constant, such as the likelihood of adopting the NFLS in favour of female headed households', increases by 91 percent and the opposite is true for male headed households. Female non-farm activities include teaching, trading, and selling of firewood.

4.3.5. *Household Size*

Large sized families are more likely to choose ALS and DLS. Results show that coefficients for family size are negative and significant for NFLS and OFLS and positive but insignificant for DLS. These coefficients indicate that small families are more likely to choose NFLS and OFLS over DLS.

4.3.6. *Farm Size*

Households having large farm size are expected to choose ALS or DLS. However, the estimated coefficients for different farm categories are inconsistent and insignificant. These results imply that landholdings have no significant role in household adoption of a livelihood strategy.

4.3.7. *Foreign Remittances*

Foreign remittances have a positive and statistically significant effect on household's adoption of nonfarm livelihood strategy (NFLS). The marginal effect value is 0.19, which means that the probability of choosing NFLS is 19 percent more for households receiving foreign remittances.

5. CONCLUSION

This study has explored the benefits of MHP at micro level in terms of diversification of households' livelihood strategies, their income and consumption expenditures. Results indicate that income and consumption expenditures of beneficiaries of MHP are significantly higher than non-beneficiaries, suggesting that launching such types of project would be helpful in bringing positive change to rural households' wellbeing.

In the study area, households are involved in agriculture, non-farm, off-farm and diversified activities as their livelihood strategies. Income from diversified livelihood strategy and non-farm livelihood strategy is significantly higher than from other two strategies. Results from multinomial logistic model further reveal that MHP has a positive significant effect on household's adoption of non-farm and diversified livelihood strategies. These findings suggest that increase in household's income and consumption occurred because of adopting non-farm and diversified livelihood strategies, and all these were made possible due to MHP projects.

Households in Northern areas of Pakistan are mostly poor farmers [Shah (2014); Shah, *et al.* (2015)], and they are not able to make a living from agriculture income alone. Based on findings from this study we can conclude that improvement in their wellbeing is only possible through livelihood diversification and that MHP projects can help in diversification of their livelihood strategies, thus raising their income and fulfilling their consumption requirements.

QUESTIONNAIRE

THE IMPACT OF SMALL HYDROPOWER PROJECTS ON SOCIOECONOMIC CONDITIONS OF LOCAL COMMUNITIES IN RURAL AREAS OF AJ&K (DISTRICT HATTIAN).

HAVING HYDROPOWER PROJECT(A)

1. Name of the respondent……..

2. Age ……..

3. Literacy status.

i. Educated ii. Uneducated

If Educated, Literacy Level

a. Primary b. Middle
c. Secondary d. Higher secondary
e. Above

4. Family size……

Adults.

i. 1-3 ii. 5-6 iii. above 6

Children.

i. 1-3 ii. 5-6 iii. above 6

5. Family type

i. Joint ii. Nuclear iii. Extended

6. No. of children going to school.

i. 1-3 ii. 5-6 iii. above 7

7 Do you own land.....

Yes..... No.....

If yes landholding size

i. Less than 1 acres
ii. 1 to 2 acres
iii. Greater than 2 acres

8i. What is your main Occupation?

i. Govt services ii. Agriculture
iii. Cattle raising iv. Business, industry, etc
v. Other (specify)…….....

8ii. What is your Subsidiary Occupation.

i. Business ii. Agriculture
iii. Cattle raising iv. Business, industry, etc
v. Other (specify)…….....

9. Is there seasonal variation in the activities?

i. Yes ii. No

If yes specify (activities)

i. _____
ii. _____
iii. _____
iv. _____

10. Did you find any employment due to SHP project

i. Yes ii. No

If yes, type of work

i. Skilled work ii. Labour
iii. Technical work iv. Administrative work
v. Others

11. Monthly income _____

i. How much you spend on energy monthly _____
ii. Any Foreign remittances----------

12. Have your family income improved due to hydroelectric project?

i. Yes ii. No

If yes then specify the nature of job from which income has increased?

i. Cottage industries ii. Job opportunity
iii. Saving from crop/livestock production iv. Other

13. Diversification in livelihood strategies due to Small hydropower Project.

Livelihood Activities	Before	Due to SHP
Agriculture Activities		
Off Farm Activities		
Non-Farm Activities		
Diversified Livelihood strategy		

14. Do you use energy source other then SHP including energy from all sources such as

i. Candles
ii. Kerosene oil
iii. Biomass
iv. Wood
v. Any other Please specify

15. If wood How much time is used to collect fuel wood
Before the project……
After the project……..

16. Do you work or do other activities after sunset

i. Yes ii. No
Any economic activities……..
Any social activities…….

17. Does Small hydro projects helped in increasing working efficiencies?

i. Yes ii. No
If Yes, please explain how……..…….

18. Is there any increase in monthly saving due to hydro electric project

i. Yes ii. No
If Yes. Then what are the reasons for that……..……

19. What is the approximate saving in Rupees You get for the following facilities per month due to near station

BHUs/Hospitals
Schools
Markets
GPO/Post offices
Banking systems

20. Where did you utilise this savings?

i. Nothing
ii. Business
iii. Livestock
iv. Agriculture

21. What are the main sources of energy for

i. Cooking ii. Heating
iii. Lighting iv. Other activities

22. Is there increase in use of home appliances after the project.

i. Yes ii. No

If Yes what type of home appliances.

i. Refrigerator ii. TV
iii. Oven iv. Iron
v. Electric cattle vi. Washing machine

23. Do you see any change in education facilities due to hydro electric project?

i. Yes ii. No

What change you see in education facilities due to hydroelectric project

i. Increase in number of school
ii. Increase in children enrolment
iii. Increase in Quantity and Quality of teachers
iv. Improved audio/video equipment
v. All of Above.

24. Do you see any change in Health facilities due to hydroelectric project.

i. Yes……. ii. No……

What change you see in Health facilities due to hydroelectric project.

i. Increase in number of Health clinics
ii. Awareness about diseases
iii. Modern equipment
iv. Sanitation
v. All of above

25. What are the most important uses of electricity?

i. Lighting ii. TV/radio
iii. Water pumping iv. Refrigerator
v. Washing machine vi. Other

26. How do you see the access to communication and entertainment services after electrification?

i. Telephone ii. Internet iii. TV
iv. Radio v. Others

27. What is your opinion for such type of project to be launched more in future?

_____

_____

_____

QUESTIONNAIRE

THE IMPACT OF SMALL HYDROPOWER PROJECTS ON SOCIOECONOMIC CONDITIONS OF LOCAL COMMUNITIES IN RURAL AREAS OF AJ&K (DISTRICT HATTIAN).

WITHOUT SMALL HYDROPOWER PROJECT(B)

1. Name of the respondent_____

2. Age_____

3. Literacy status.

i. Educated ii. Uneducated

If Educated, Literacy Level

a. Primary b. Middle
c. Secondary d. Higher secondary
e. Above

4. Family size……

Adults.

i. 1-3 ii. 5-6 iii. above 6

Children.

i. 1-3 ii. 5-6 iii. above 6

5. Family type

i. Joint ii. Nuclear iii. Extended

6. No. of children going to school.

i. 1-3 ii. 5-6 iii. above 7

7 Do you own land.....

Yes..... No.....

If yes landholding size.....

8i. What is your main Occupation?

i. Govt services ii. Agriculture
iii. Cattle raising iv. Business, industry, etc.
v. Other (specify)…….....

8ii. What is your Subsidiary Occupation.

i. Business ii. Agriculture
iii. Cattle raising iv. Business, industry, etc.
v. Other (specify)…….....

9. Is there seasonal variation in the activities?

i. Yes ii. No

If Yes Specify (activities)

i. _____
ii. _____
iii _____
iv _____

Monthly income _____

10. Diversification in livelihood strategies

Livelihood Activities		
Agriculture Activities		
Off Farm Activities		
Non-Farm Activities		
Diversified Livelihood strategy		

How much you spend on energy monthly _____

11. Have your family income affected due to shortage of electricity?

i. Yes ii. No

(ii) If yes then specify the nature of job from which it has been effected?

i. Cottage industries ii. Job opportunity
iii. Saving from crop/livestock production iv. Other

12. Your alternative energy source during load shedding hours?

i. Candles
ii. Kerosene oil
iii. Biomass
iv. Wood
v. Any other Please specify

13. Do you work or do other activities after sunset

i. Yes ii. No

Any economic activities……..

Any social activities…….

14. Does load shedding affect your working efficiencies?

i. Yes ii. No

If Yes, please explain how……..…….

15. Is there any increase in monthly expenditure for using alternate energy sources?

i. Yes ii. No

If Yes. Then what are the reasons for that……..…….

16. What are the main sources of energy for

i. Cooking ii. Heating
iii. Lighting iv. Other activities

17. Is there any decrease in use of home appliances due to load shedding?

i. Yes ii. No

If Yes what type of home appliances.

i. Refrigerator ii. TV
iii. Oven iv. Iron
v. Electric cattle vi. Washing machine

18. What are the most important uses of electricity?

i. Lighting ii. TV/radio
iii. Water pumping iv. Refrigerator
v. Washing machine vi. Other

19. How do you see the access to communication and entertainment services due to unavailability of electricity?

i. Telephone ii. Internet
iii. TV iv. Radio
v. Others

20. What is your opinion to overcome such type of crisis in future?

_____

_____

_____

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Oil Price Shocks, Systematic Monetary Policy and Economic Activity

MUHAMMAD ZESHAN, WASIM SHAHID MALIK, and MUHAMMAD NASIR

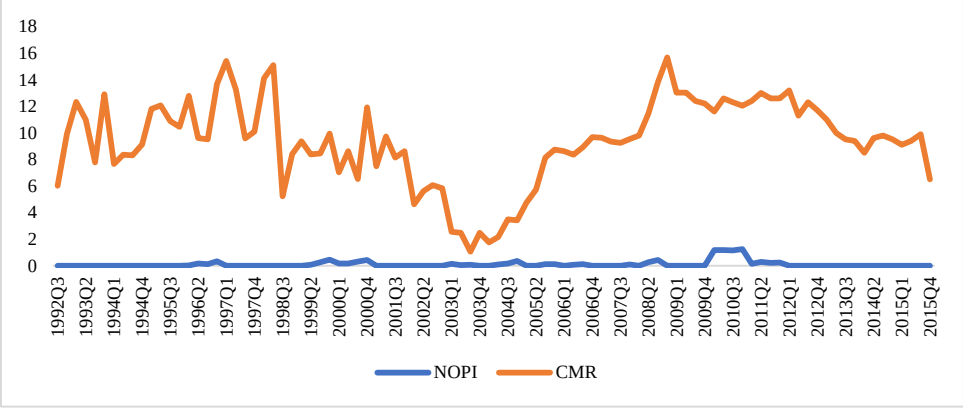
This study quantifies the impact of oil price shocks and the subsequent monetary policy response on output for Pakistan. It employs a quarterly Structural Vector Auto-regression framework for the period 1993–2015. It first discovers that Hamilton's (1996) Net Oil Price Increase indicator appropriately reveals most of the oil price shocks hitting Pakistan's economy. We find that a contractionary monetary policy, resulting from the oil price shocks, contributes to significant output loss in Pakistan. After encountering the Lucas critique, the present study finds that around 42 percent of the output loss is due to the ensuing tight monetary policy. This suggests that the central bank of Pakistan can reduce the impact of oil price shocks by reducing its intervention in the market.

JEL Classification: E1, E3, E5
Keywords: Oil Price Shocks, Monetary Policy, Structural Vector Autoregression

1. INTRODUCTION

Applying two simulation methods [Sims and Zha (1996); Bernanke, *et al.* (2004); Nusair (2016); Razmi, *et al.* (2016)], we find that a contractionary monetary policy resulting from the oil price shocks contributes to an output loss in Pakistan. Figure 1 elaborates a negative relationship between the oil price shocks and the tight monetary policy response pursued by the central bank of Pakistan.

Fig. 1. Oil Price Shocks and Monetary Policy in Pakistan



Note: NOPI is the oil price shock and CMR is call money rate. Further details of these variables are available in data section.

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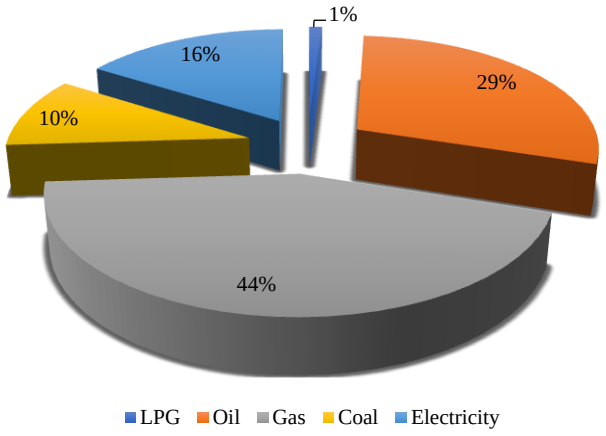
Further, Knittel and Roberts (2005) suggest that a positive shock to oil price represents an unexpected demand shock driven by global economic activity. Each simulation method gives the same message that a tighter monetary policy resulting from oil price shocks increases output loss. The output loss from the monetary policy is around 12 percent in the Sims and Zha (1996) scenario while it is around 42 percent in Bernanke, *et al.* (2004) scenario. It is important to note that the latter scenario provides robust results as it encounters the Lucas critique. On the other hand, the oil price shocks alone are responsible for the remaining 88 percent of output loss in Sims and Zha (1996) scenario and for a 58 percent output loss in Bernanke, *et al*. (2004) scenarios.

During the fiscal year 2012-13, primary energy supply in Pakistan was around 64, 727 thousand tons of oil equivalent (TOEs), as compared to 64,522 thousand TOEs during the last year. This indicates a growth rate of 0.32 percent. On the other hand, final energy consumption during 2012-13 was around 40, 026 thousand TOE. The growth rate of energy consumption has increased by 3.1 percent. This energy consumption is highly skewed in favour of natural gas and oil consumption, Figure 2 portrays a detailed analysis of the energy mix in Pakistan.

Fig. 2. Energy Mix in Pakistan for 2012-13



Source: Hydrocarbon Development Institute of Pakistan, 2012-13.
Note: During 2012-13, final energy consumption in Pakistan was around 40, 026 thousand TOE.

For decades, oil price shocks have been held responsible for prolonged recessions worldwide. This assertion is based on the close correlation between the oil price shocks and economic downturns. The fact that oil price shocks precede all the major recessions further strengthens this claim [Hamilton (1983)]. Nonetheless, all the economists do not share the same opinion. A few believe that neither oil price shocks [Bruno and Sachs (1985)] nor the oil intensity has something to do with the recession [Baily (1982)], as the energy expenses account for a meagre share in the total cost. There appears to be some other factor worsening the situation and Bohi (1991) believes that it is a tighter monetary stance of the monetary authorities in the face of oil shocks.

Being a net oil importer, Pakistan is prone to international oil price shocks in terms of output loss and inflation. This also points to the importance of variations in the nominal and

real exchange rates for the reason that a decrease in the value of rupee will increase the burden of import bill, thereby affecting the economic activity. Figure A1 (Appendix B) shows the variations in the real and nominal exchange rates for Pakistan in the first decade of the new millennium. Moreover, given a narrow oil supply base, an unexpected increase in oil price (which is a demand shock) makes the economy more fragile. Consequently, any oil price shock becomes a matter of concern for the monetary authorities in setting the policy rate, so as to minimise the welfare loss to the society. However, the dilemma is that a tight monetary stance to limit inflation may result in more output loss through the investment channel of demand. In this backdrop, it is very important to investigate the nature of the relationship between oil price shocks and the subsequent monetary policy.

The only study in Pakistan in this perspective is that of Malik (2008), who finds that oil price shocks have a significant and asymmetric relationship with macroeconomic variables. Nevertheless, the study is limited in the sense that it does not discriminate between the anticipated and unanticipated policy responses.[1] Unfortunately, no study till date, including the aforementioned one, has explicitly distinguished between the output loss, associated with oil price shocks and the one due to the endogenous monetary policy response. Hence, the present study finds an opportunity to fill this gap in the literature.

The rest of the study is organised as follows: the literature review is given in Section 2. The third section describes the theoretical framework and econometric modelling. Section 4 presents a brief description of data and variables. The results are discussed in Section 5 while Section 6 concludes the study and provides policy recommendations.

2. LITERATURE REVIEW

There is extensive literature on the nexus between oil price (demand) shock, economic fluctuations and monetary policy [Nusair (2016); Razmi, *et al.* (2016); Elwell (2013); Alquist and Coibion (2013)]. Macro-economists differ on the appropriate policy response by the monetary authorities to oil shocks [Hetzel (2013); Meltzer, *et al.* (2013)]. Gordon (1975), for instance, favoured monetary accommodation, in case the economy is hit by an adverse supply shock. Blinder (1981) argued in favour of monetary contraction in such situations. Nonetheless, Fischer (1985) advised the monetary authorities to restrain from any response as long as the workers do not resist any real change in wages.

It was believed for years that output loss in an economy facing oil price shocks is entirely the consequence of these shocks. However, it was the pioneering work of Bohi (1991) which considered the tight monetary policy following oil price shocks as the main cause of the output loss. Dotsey and Reid (1992) also shared the same view. However, these studies fail to quantify the production shortfall associated with the oil price shocks and the systematic monetary policy. This gap was filled by Bernanke, *et al*. (1997) by employing monthly VAR for this purpose. Results showed that oil price shocks induced a significant policy response in the form of increased interest rate. The identification problem made it difficult for them to separate the production loss associated with both the shocks and the subsequent monetary policy. To deal with this problem, the study employed Sims and Zha (1996) counterfactual experiments to observe that oil price

[1]Also, this study has not considered the financial reforms of 1990s that allowed the State Bank of Pakistan (the central bank of Pakistan, SBP) for market determined policy rate.

shocks have a minor negative impact on the real GDP, while the resulting tight monetary policy was responsible for 2/3 to 3/4 of the output loss. This was the first effort of sorting out the effect of the systematic monetary policy on the economic activity in the face of oil shocks. Following Bernanke, *et al*. (1997), Lee, *et al.* (2001) uncovered that oil price shocks had the potential to predict movements in the monetary policy in response to the oil shocks in Japan with 30 percent to 50 percent of the output loss attributable to the systematic monetary policy.

Nonetheless, the findings of Bernanke, *et al*. (1997) were questioned for two reasons. First, the strength and accuracy of the counterfactual experiments were doubtful, thereby leading to the so called Lucas critique. Secondly, the lag length selected by Bernanke, *et al*. (1997) was not appropriate [Hamilton and Herrera (2004)]. This second query is raised on the basis that oil shocks take three to four quarters in revealing their impact on output [Herrera (2007); Hamilton (2003)]. Therefore, for monthly data, it is advisable to place 12 lags instead of 7 as was done in Bernanke, *et al*. (1997). Hamilton and Herrera (2004) exercised the same dataset used in Bernanke, *et al*. (1997) and employed VAR framework for analysis. The study concluded that the lag length mis-specification in Bernanke, *et al*. (1997) was behind the huge output loss that was assumed to be associated with the systematic monetary policy. The study further claimed that the monetary policy would no more be responsible for output loss if the lag length is extended to 12.

Bernanke, *et al*. (2004) tried to settle the issues contemporaneously. The study argued that excessive lags could enhance the uncertainty in the model rather than avoiding the variable omission bias. Consequently, they employed 4 lags but with quarterly data, so as to ensure a more parsimonious model along with minimum uncertainty and mean square error. Moreover, they preferred to delay the policy response for four quarters instead of completely shutting it off in the model. Because a transitory deviation cannot deform the structure of the economy completely, it provided a possible solution for the Lucas critique as well. This experiment exhibited that the endogenous monetary policy was still responsible for half of the output loss, a bit lesser than their previous findings. Working with 6 lags, it again verified association of the output loss with the ensuing tight monetary policy.

Following Bernanke, *et al.* (2004), Herrera and Pesavento (2009) used quarterly data to minimise uncertainty in the sample data. With 4 lag length and delayed policy response for 1 year, the study came up with the same view as asserted previously. Splitting the data into two sets, owing to some structural break, it declared that the systematic monetary policy had some dampening impact on the economy during the 1970s with no contribution in the economic downturn in the later years.

In an attempt to evaluate the validity of Bernanke, *et al*. (2004), Carlstrom and Fuerst (2005) estimated a calibrated version of the General Equilibrium Model. It was suggested that unanticipated policy in terms of delayed policy response could minimise the output loss. Leduc and Sill (2004) also conducted various policy scenarios to evaluate the economic performance within the same framework and the results were consistent with the Bernanke, *et al*. (1997, 2004). Lee and Song (2009) concluded that the accommodative monetary policy trims down the output volatility without raising inflation significantly.

3. ECONOMETRIC METHODOLOGY

3.1. Structural Vector Autoregression (SVAR)

The SVAR is the most extensively used framework for the analysis of oil shocks and monetary policy. This framework is especially helpful in quantifying the output loss. Hence, following Kliem and Kriwoluzky (2013), Lange (2013) and Bernanke, *et al.* (1997, 2004) among others, we estimate a Structural VAR.[2]

However, Kilian and Vigfusson (2011) state that the presence of a censored variable (which is NOPI in the present case) will make the impulse responses inconsistent. To avoid this problem, Kilian and Vigfusson (2011) suggest to use oil price such that it is predetermined with respect to other macroeconomic variables. This is evident from Equation 1 where (domestic real) oil price is dependent only on the predetermined macroeconomic variables. Further, the study suggests to use NOPI in all other equations other than the oil price equation.

$$DROP_t = \alpha_{10} + \sum_{i=1}^{p} \alpha_{11,i}\, DROP_{t-i} + \sum_{i=1}^{p} \alpha_{12,i}\, CPI_{t-i} + \sum_{i=1}^{p} \alpha_{13,i}\, Y_{t-i} + \sum_{i=1}^{p} \alpha_{14,i}\, CMR_{t-i} + \varepsilon_{1,t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$CPI_t = \alpha_{20} + \sum_{i=0}^{p} \alpha_{21,i}\, DROP_{t-i} + \sum_{i=1}^{p} \alpha_{22,i}\, CPI_{t-i} + \sum_{i=0}^{p} \alpha_{23,i}\, Y_{t-i} + \sum_{i=0}^{p} \alpha_{24,i}\, CMR_{t-i} + \sum_{i=0}^{p} \alpha_{25,i}\, NOPI_{t-i} + \varepsilon_{2,t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

$$Y_t = \alpha_{30} + \sum_{i=1}^{p} \alpha_{31,i}\, DROP_{t-i} + \sum_{i=0}^{p} \alpha_{32,i}\, CPI_{t-i} + \sum_{i=1}^{p} \alpha_{33,i}\, Y_{t-i} + \sum_{i=0}^{p} \alpha_{34,i}\, CMR_{t-i} + \sum_{i=0}^{p} \alpha_{35,i}\, NOPI_{t-i} + \varepsilon_{3,t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

$$CMR_t = \alpha_{40} + \sum_{i=0}^{p} \alpha_{41,i}\, DROP_{t-i} + \sum_{i=0}^{p} \alpha_{42,i}\, CPI_{t-i} + \sum_{i=0}^{p} \alpha_{43,i}\, Y_{t-i} + \sum_{i=1}^{p} \alpha_{44,i}\, CMR_{t-i} + \sum_{i=0}^{p} \alpha_{45,i}\, NOPI_{t-i} + \varepsilon_{4,t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

Here $DROP_t$ is the domestic real oil prices, Y_t is the real GDP, CPI_t is the Consumer Price Index, CMR_t is the call money rate, $NOPI_t$ is Hamilton's (1996) oil price indicator and finally ε_i are the white noise structural shocks. The SVAR can be estimated with the help

[2]Initial literature considered the exclusion of commodity prices from a VAR framework as a reason for the price puzzle. Sims (1992) suggested the inclusion of commodity prices in order to avoid this puzzle. However, Leeper, *et al*. (1996) argued that the inclusion of commodity prices without theoretical justifications may also result in some serious specification bias. Fortunately, there is no price puzzle in the present study so it does not use commodity price index. It provides us two additional benefits. First it avoids the use of the *ad-hoc* based commodity price index in the VAR framework. Second, it makes the model more parsimonious and thereby reduces uncertainty in its estimates.

of Ordinary Least Square (OLS) technique, since it contains the same independent variables on the right hand side (RHS). Nonetheless, a different composition of the right hand side variables will require the Seemingly Unrelated Regression [Enders (2004)]. This estimation is performed in two steps. First, it estimates the reduced form parameters of the system. Second, it derives the structural parameters of the model for inferential analysis. Equations 1-4 summarise the identifying restriction for the estimation of structural parameters; it is based on Kilian and Vigfusson (2011). In these equations, oil price is predetermined with respect to other macroeconomic variables. It is domestic real oil price, dependent only on the predetermined macroeconomic variables. The rest of the identifying restrictions are as follows: since Pakistan is the net oil importer, it cannot affect international oil prices. However, being a net importer, it is affected by oil price shocks. Due to inertia, output is contemporaneously affected neither by oil price nor by interest rate. Finally, the interest rate does not affect prices in the same period due to rigidities in the economy.

3.2. Sims-Zha Counterfactual Experiments

Next we discuss how the output losses, due to the rising oil price and the subsequent tight monetary policy, can be separated, using the Sims-Zha framework. Sims and Zha (1996) made the first effort to quantify the impact of the endogenous monetary policy in the VAR framework, by shutting-off the monetary policy response.

Historically, a central bank tightens monetary policy in response to rising oil prices because it fears that higher oil prices would increase inflation and inflationary expectations. Hence, it is not only the oil price increase that is contributing to the macroeconomic changes but also tighter monetary policy. From a policy perspective, it would be important to know which factor (oil price increase or tight monetary policy) is contributing how much in the changing macroeconomic activity.

In order to separate the output losses resulting from the oil price increase and the tight monetary policy, shutting-off the monetary policy would provide only the contribution of oil price increase to the change in macro-economy. It is important to note that the interest rate is primary policy rate used by the policy-makers. Shuting-off the monetary policy (interest rate) means that it should remain the same as it was before the oil price increase [Sims and Zha (1996)].

The monetary policy becomes non-responsive to the macroeconomic fluctuations and plays a passive role only. The output loss due to tight monetary policy is then the difference between the output losses occurred with and without shut-off cases. Nonetheless, this unexpected policy response results in the Lucas critique; the reason is that Sims and Zha (1996) scenario considers that the behaviour of economic agents is invariant to this policy change. In practice, any simulation in this way would lead to the Lucas critique as, in the shut-off case, the policy is not responding in a historical way.

Sims and Zha (1996) find that an unpredictable shift in the monetary policy accounts for a little variation in the historical macroeconomic fluctuations. Further, it finds a small variation in policy rate in response to such variations. It concludes that most of the monetary policy reactions are systematically in response to business cycle changes. In such situation, assessment of systematic monetary policy becomes more important.

This framework estimates such a monetary policy reaction function in which the policy variable is completely unresponsive to any shock. In other words, the central bank does not allow for any change in policy in response to a macroeconomic disturbance. Further, this framework does not allow for any change in behaviour of private sector agents. It assumes that private agents fully understand the new policy.

Data reveals that interest rate increases in response to an oil price shock, which is a historical fact, but the above mentioned practice with simulation is not conducted following this historical response to the interest rate. This is an alarming issue as in the presence of Lucas critique all the policy simulations would be worthless. Fortunately, this problem is solved in Bernanke, *et al*. (2004) by delaying the response of monetary policy for a year instead of completely shutting it off. Since a transitory deviation of the monetary policy from the traditional policy response will not deform the economic structure completely, the effect of Lucas critique is minimal in this case**.**

4. DATA AND VARIABLES

The present study uses the following main variables: real Gross Domestic Product (GDP), Consumer Price Index (CPI), domestic real oil prices (DROP), the Hamilton's (1996) oil price indicator (Net Oil Price Increase, NOPI) and the Call Money Rate (CMR).[3] It uses quarterly data for the period 1993 to 2015.[4] All these series are in real terms, denominated in the million rupees with 2000 as the base year.

Energy prices are state-controlled in Pakistan. These prices may not be perfect representatives of international oil price behaviour, yet we also use them in our analysis to judge their impact on the economy. Domestically controlled energy prices comprise of Gasoline, Kerosene, High Speed Diesel Oil (HSDO), Light Diesel Oil (LDO) and HOBC.

Data for quarterly GDP have been obtained from Kemal and Arby (2005). However, quarterly GDP available only till 2004-05. Data for the remaining period are acquired from Nasir and Malik (2011). The data for international oil prices are taken from the Illinois Oil and Gas Association (IOGA). The IOGA was established in 1944 in the United States to provide information to its stakeholders about the energy inputs. Pakistan Energy Year Book is consulted for data on domestic energy prices. The data for both prices and call money rate are taken from various reports of the State Bank of Pakistan.

5. RESULTS AND DISCUSSION

For the sake of convenience, this section has been divided into three subsections. The first subsection 5.1 provides the results of unit root test. The second subsection 5.2 portrays the impulse responses of output loss. Finally, the last subsection 5.3 sorts out the output loss, resulting from the oil price shocks and the systematic monetary policy.

[3]The selection procedure for an oil price indicator has been specified in Appendix.

[4]A model with monthly data may raise the sampling error significantly, for the uncertainty is intensified in the presence of large number of variables in the model. The issue even worsens if the lag length is also large. A quarterly series ensures a parsimonious model, with minimum uncertainty and mean square error [Bernanke, *et al.* (2004)]. This provides motivation for the use of quarterly data in this empirical analysis. One might argue to use the annual data for a more parsimonious model. However, annual data is unable to capture the true dynamics of the economy which the quarterly data can. The data is deseasonalised to control for seasonality effects.

5.1. Results of Unit Root Test and Lag Selection

Results of unit root tests indicate that three out of the four variables are non-stationary (see Table 1). More specifically, just NOPI is stationary while the CMR, CPI and the GDP are I (1). The standard econometric practice suggests to use the integrated variables with first difference. The results of the ADF test indicate that all the integrated variables are stationary at the first difference with varying level of significance. Hence, the present study employs CMR, CPI and the GDP with the first difference while the DROP and NOPI with level form.

Table 1

Results of Unit Root Test

Variables	Augmented Dickey-Fuller (ADF) Test	
	Level	First Differernce
CMR	–2.5	–7.2***
CPI	–0.98	–4.3**
GDP	–2.1	–3.2*
DROP	–3.9**	–9.15***
NOPI	–5.1***	–8.23***

Note: NOPI is stationary while the CMR, CPI and the GDP are integrated of I (1).
***, ** and * indicate 1 percent, 5 percent and 10 percent level of significance respectively.

The present study takes the help of HQC (Hannan-Quinn criterion) and AIC (Akaike criterion) for lag selection, see Table 3 for details. The former criterion specifies the use of 4 lags [consistent with Bernanke, *et al.* (2004)] while the latter criterion specifies the use of 5 lags. As Bernanke, *et al.* (2004) suggests the use of 4 lags with quarterly data, the primary study estimates the baseline estimation with the 4 lags. However, it also estimates a robustness test with a 5 lag model, suggested by our AIC test. The detailed results of both of these models (models with 4 lags and 5 lags) have been explained in the next section.

Table 2

Lag Selection Criteria

Lags	HQC (Hannan-Quinn Criterion)	AIC (Akaike Criterion)
1	–9.45	–9.66
2	–10.08	–10.42
3	–10.07	–10.53
4	–10.23*	–10.82
5	–10.14	–10.85*
6	–9.97	–10.81
7	–9.76	–10.73
8	–9.63	–10.72

* Indicates the best (that is, minimised) values.

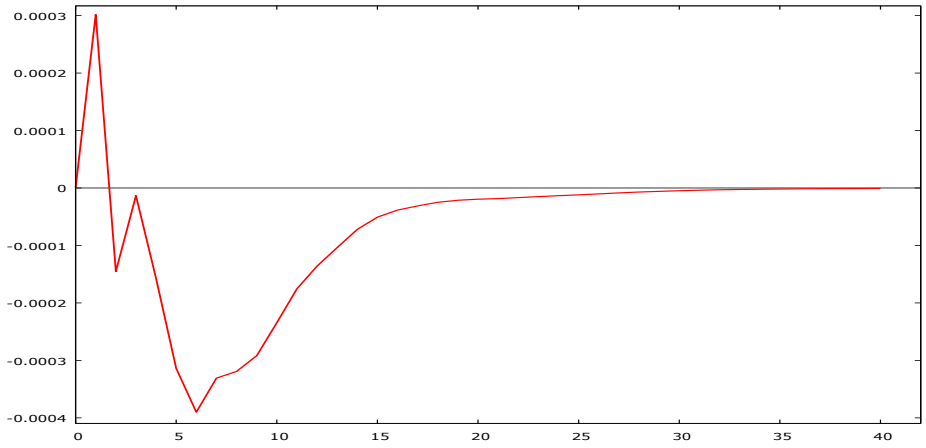
5.2. Impulse Responses of Output Loss

The Figures 3, 5 and 7 show the output loss, resulting from a systematic monetary policy, non-systematic monetary policy [Sims-Zha Scenario] and delayed monetary policy [Bernanke, *et al.* (2004) scenario]. All these models have been estimated with 4 lags.[5] Results show that the oil price shocks have an adverse impact on the economy. This impact is more pronounced if the monetary authorities operate aggressively with a systematic monetary policy to control the forthcoming inflationary episode. However, in the absence of a systematic (or with a delayed) monetary policy, the impact of the oil price shocks on the macroeconomic downturn can be reduced significantly. Further, it is evident that the economy has an early tendency of convergence after encountering the Lucas critique, see Figure 7, while there is no such tendency in the other case.

For a diagnostic analysis, the present study checks the distribution of residuals through the Doornik-Hansen test. Under the null hypothesis of normality, the Doornik-Hansen test determines the distribution characteristics of residuals of an estimated model. Test results show that the null of each of the three models is accepted. It means residuals of these models are normally distributed which signifies the robustness of all these models, see Table 4.

The present study also runs robustness tests, but with 5 lags. The Figures 4, 6 and 8 show the output loss resulting from a systematic monetary policy, non-systematic monetary policy [Sims-Zha Scenario] and delayed monetary policy [Bernanke, *et al.* (2004) scenario]. All these estimated models convey the same message but the 5 lag models are more volatile than the 4 lag models. Though the results of 5 lag models are consistent with 4 lag models, but they are less stable over time.

Fig. 3. Output Loss with Systematic Monetary Policy
(4 lag model)

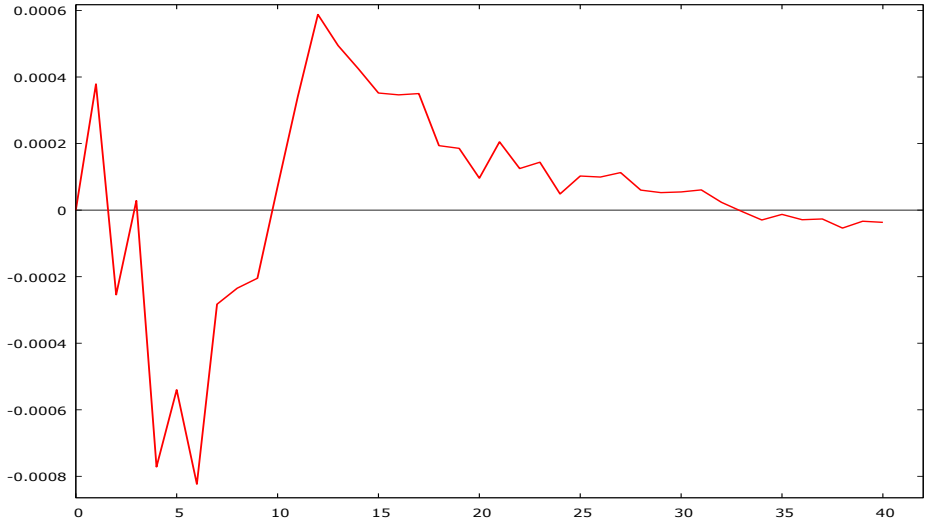


Source: Authors' calculations.

Note: The impact of oil price shocks is more devastating if the monetary authorities operate aggressively with a systematic monetary policy to control the forthcoming inflationary episode. (These are the standard results of gretl software with a 95 percent level of confidence.)

[5] Our model is identified locally and globally. Further, the covariance matrix of residuals is full and the matrix of structural shocks is diagonal.

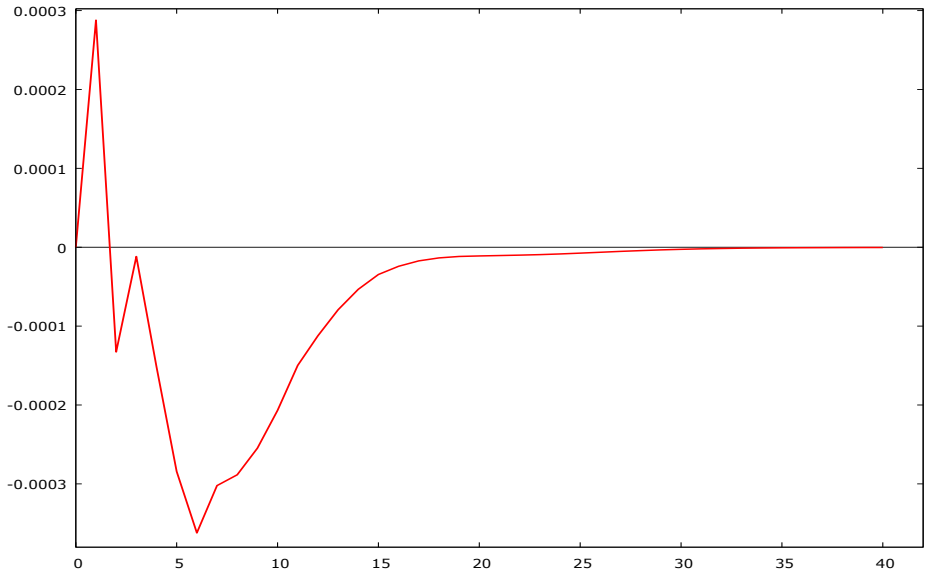
Fig. 4. Output Loss with Systematic Monetary Policy
(5 lag model)



Source: Authors' calculations.

Note: The impact of systemetic monetary policy is devastating and more volatile with a 5 lag model. This model converges after a long period of time compared to a 4 lag model. (These are the standard results of gretl software with a 95 percent level of confidence.)

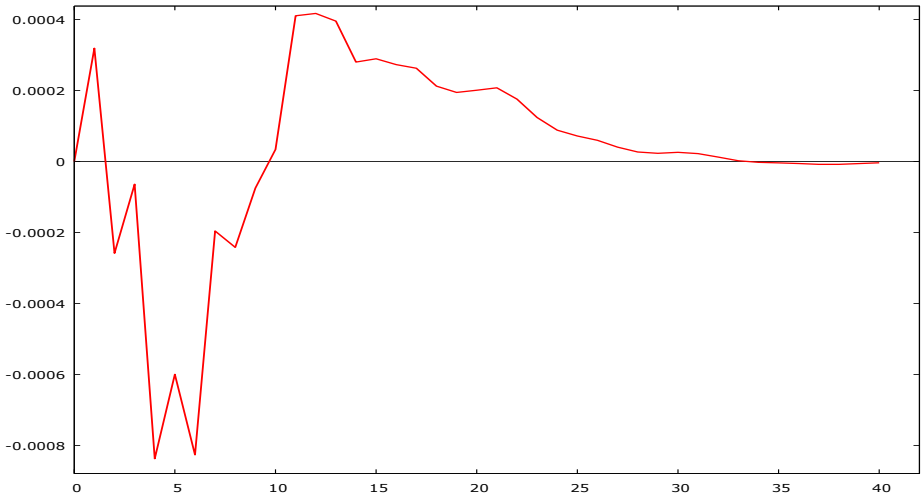
Fig. 5. Output Loss with a Non-systematic Monetary Policy [Sims-Zha Scenario]
(4 lag model)



Source: Authors' calculations.

Note: In the absence of a systematic monetary policy, the adverse impact of the oil price shock of macroeconomic downturn can be reduced by 12 percent. (These are the standard results of gretl software with a 95 percent level of confidence.)

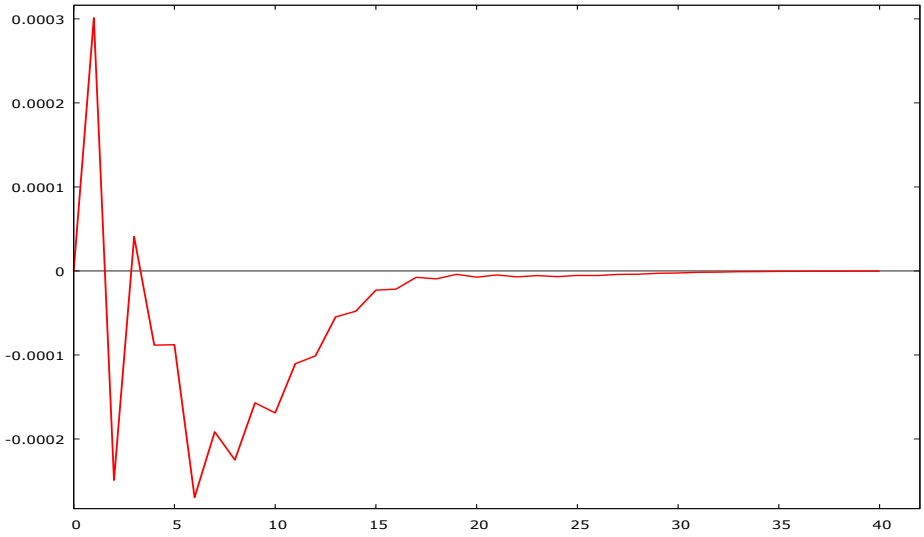
Fig. 6. Output Loss with a Non-systematic Monetary Policy [Sims-Zha Scenario]
(5 lag model)



Source: Authors' calculations.

Note: The impact of systemetic monetary policy is devastating and more volatile with a 5 lag model. This model converges after a long period of time compared to a 4 lag model. (These are the standard results of gretl software with a 95 percent level of confidence.)

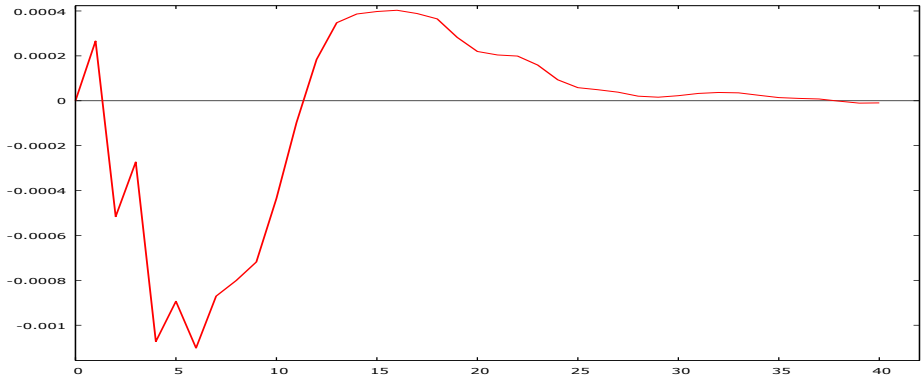
Fig. 7. Output Loss with a Delayed Monetary Policy
[Bernanke, *et al.* (2004) Scenario]
(4 lag model)



Source: Authors' calculations.

Note: In the absence of a systematic monetary policy, the adverse impact of the oil price shock of macroeconomic downturn can be reduced by 42 percent. (These are the standard results of gretl software with a 95 percent level of confidence.)

Fig. 8. Output Loss with a Delayed Monetary Policy
[Bernanke, *et al.* (2004) Scenario]
(5 lag model)



Source: Authors' calculations.

Note: The impact of systemetic monetary policy is devastating and more volatile with a 5 lag model. This model converges after a long period of time compared to a 4 lag model. (These are the standard results of gretl software with a 95 percent level of confidence.)

Table 3

Distribution of Residuals

Doornik-Hansen	Systemetic Monetary Policy Scenario	Bernanke Scenario	Sims-Zha Scenario
Test Statistic	9.12	9.59	10.04

5.3. Quantification of Output Loss

With the help of these three impulse response scenarios, we attribute the output loss to oil shocks and the subsequent tight monetary policy. This output loss, calculated for 12 quarters (three years) is given in Table 5. The table has 2 major blocks. The first block presents two different scenarios which control the systematic response of monetary policy, while the second block illustrates the respective shares of output loss due to the oil price shock and the monetary policy.

Two important points emerge from this table. First, the contractionary monetary policy contributes to output loss. Second, in Sims-Zha and Bernanke, *et al.* (2004) scenarios, the monetary policy contributes around 12 percent and 42 percent in the output losses respectively. It is important to note that the latter case is more robust as it encounters the Lucas critique. The oil price shocks are responsible for around 88 percent and 58 percent of the output losses in the respective scenarios. It indicates that an endogenous monetary policy contributes significantly in the output loss. In other words, if the State Bank of Pakistan avoids interfering the supply side shocks, to control inflation, the output loss will be minimal.[6]

[6]Same practice is repeated for the domestically controlled energy prices such as Gasoline, Kerosene, High Speed Diesel Oil (HSDO), Light Diesel Oil (LDO) and HOBC. No energy shock was able to produce any well behaved response in the series. One possible reason might be the presence of distortions in the energy prices due to state control. We omit its graphical analysis to save some space.

Table 4

Quantification of Output Loss

	Contribution in Output Loss by	
	Oil Price Shock	Monetary Policy
Shut-off Case	88%	12%
Delayed Monetary Policy	58%	42%

Source: Author's calculations.

Note: Two lessons can be learned. First, the contractionary monetary policy is the prime contributor to output loss. Second, the output loss is higher if the endogenous monetary policy is working endogenously.

6. CONCLUSION AND POLICY IMPLICATIONS

After encountering the Lucas critique in the Sims and Zha (1996) counterfactual experiments, this study finds that around 42 percent of the output loss is due to the ensuing tight monetary policy. The important policy implication of this study is that the State (Central) Bank of Pakistan should not intervene in the market process if the general price level is increasing due to an oil price shock. Hence, if the State Bank intervenes in the market mechanism to control the rising inflationary expectations from the increasing oil prices, it would further increase output loss.

As a higher interest rate increases the cost of doing business, resultantly it has a negative impact on business activity. The worst impact would be on investment which is much volatile to the increase in interest rate. Muhammad, *et al.* (2013) finds that a 1 percent increase in interest rate reduces investment by 0.44 percent. This crowing out would curtail the role of private sector in the market.

The macroeconomic effects of a demand based oil price shock are quite different in the presence of an ensuing tight monetary policy. After such an oil price shock, inflation rate and output both are expected to rise initially. However, given the commitment of a central bank to price stability, it increases interest rate to stabilise prices. As the investment is much volatile to increasing interest rate, output starts falling. The tight monetary policy hinders the economic growth rate and eventually results in output losses.

APPENDIX A

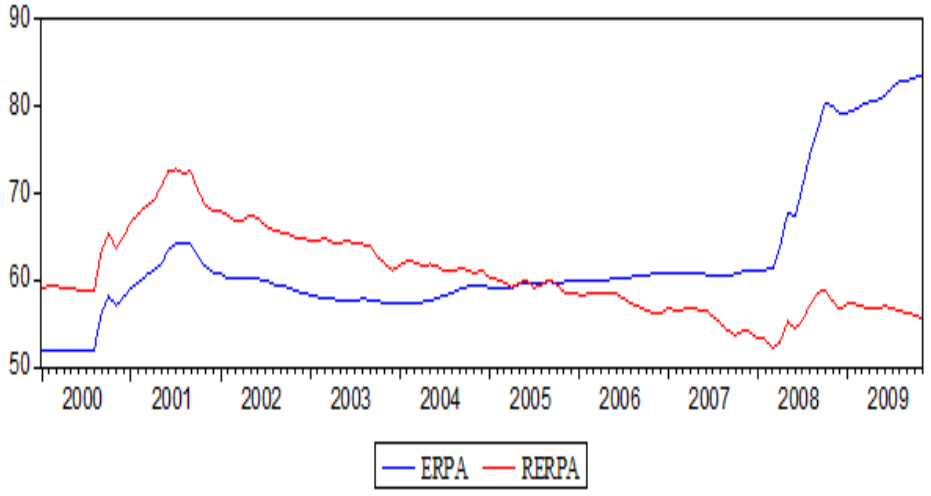
IDENTIFICATION OF APPROPRIATE OIL PRICE INDICATOR

It is not an easy task to uncover the appropriate measure for oil price shock. Change in the nominal oil price was the first indicator introduced by Hamilton (1983). However, this indicator was unable to add much in the empirical literature [Alquist and Coibion (2013); Hetzel (2013); Elwell (2013); Meltzer, *et al.* (2013); Prieto, *et al.* (2013)]. A more effective and comprehensive oil price shock indicator was required that could unearth the causal relationship among the macroeconomic variables. Subsequently, some other indicators such as log of the real oil price and log difference of real oil price among others were introduced. However, the most comprehensive and commonly used indicator is the Net Oil Price Increase (NOPI), presented by Hamilton (1996) [Lee, *et al.* (2001); Bernanke, *et al*. (1997)]. It is the log of the ratio of quarterly present time real oil price (denominated in local currency) to the previous year's maximum level.

The first task of this study, therefore, is to identify an appropriate indicator for oil price shock for Pakistan. Oil prices have asymmetric relationship with macroeconomic variables in Pakistan [Malik (2008)], and a positive change in the oil prices brings more variation in macroeconomic indicators than do the negative one [Hamilton (1996)]. Based on this reasoning, the Hamilton's (1996) Net Oil Price Increase (NOPI) indicator appears to be most appropriate. Moreover, Hooker (1996) also finds that this indicator remains stable over time. However, in order to come up with concrete conclusion, other indicators mentioned in the previous paragraph are also analysed, by observing the impact of these indicators on output, prices and policy rate. For an indicator to be appropriate, it should decrease output, increase prices and interest rate in the face of a positive oil price shock. Given these criteria, we found that Hamilton's (1996) NOPI is the most suitable indicator in this analysis because it produces the well behaved impulse responses in the face of oil shocks.

APPENDIX B

Fig. A1. Real and Nominal Exchange Rates Behaviours



Appendix Table 1

Regressions

	GDP_L	CPI_L	NOPI	CMR
GDP_L(-1)	1.6	–0.4	–1.7	100.6
	–0.1	–0.7	–6.9	–105.0
	[12.1]	[–0.6]	[–0.2]	[0.99]
GDP_L(-2)	–0.1	0.7	–11.0	–74.5
	–0.3	–1.4	–14.5	–221.5
	[–0.5]	[0.5]	[–0.7]	[–0.3]
GDP_L(-3)	–1.0	–0.5	29.3	–159.1
	–0.3	–1.5	–15.6	–239.2
	[–3.2]	[–0.3]	[1.8]	[–0.6]
GDP_L(-4)	0.5	0.3	–17.5	160.0
	–0.2	–0.8	–8.1	–124.6
	[3.4]	[0.4]	[–2.1]	[1.2]
CPI_L(-1)	–0.1	1.6	2.8	25.6
	0.0	–0.2	–1.7	–25.6
	[–2.3]	[9.9]	[1.6]	[0.9]
CPI_L(-2)	0.1	–1.0	–3.7	1.7
	–0.1	–0.3	–3.1	–46.7
	[2.1]	[–3.5]	[–1.2]	[0.0]
CPI_L(-3)	0.0	0.7	1.1	–36.9
	–0.1	–0.3	–3.4	–51.4
	[0.7]	[2.0]	[0.3]	[–0.7]
CPI_L(-4)	–0.1	–0.3	0.4	–8.4
	0.0	–0.2	–1.8	–28.0
	[–2.8]	[–1.6]	[0.2]	[–0.2]
NOPI(-1)	0.0	0.0	0.3	2.9
	0.0	0.0	–0.2	–2.4
	[0.6]	[0.7]	[1.9]	[1.2]
NOPI(-2)	0.0	0.0	–0.1	2.3
	0.0	0.0	–0.2	–2.5
	[–1.4]	[–1.2]	[–0.8]	[0.8]
NOPI(-3)	0.0	0.0	0.1	2.2
	0.0	0.0	–0.2	–2.6
	[–0.4]	[0.6]	[0.4]	[0.8]
NOPI(-4)	0.0	0.0	0.0	4.0
	0.0	0.0	–0.2	–2.3
	[–0.7]	[–0.6]	[–0.3]	[1.7]
CMR(-1)	0.0	0.0	0.0	0.2
	0.0	0.0	0.0	–0.1
	[–2.1]	[–1.2]	[–0.5]	[1.6]
CMR(-2)	0.0	0.0	0.0	0.1
	0.0	0.0	0.0	–0.1
	[–0.9]	[1.1]	[0.5]	[0.4]
CMR(-3)	0.0	0.0	0.0	0.1
	0.0	0.0	0.0	–0.1
	[–0.6]	[–0.6]	[–0.4]	[0.7]
CMR(-4)	0.0	0.0	0.0	0.5
	0.0	0.0	0.0	–0.1
	[–0.3]	[1.1]	[–0.3]	[3.7]
C	0.0	–1.5	9.7	–289.9
	–0.1	–0.6	–6.8	–103.9
	[–0.3]	[–2.3]	[1.4]	[–2.7]
R-squared	1.0	1.0	0.3	0.8
Adj. R-squared	1.0	1.0	0.0	0.7
Sum sq. resids	0.0	0.0	0.6	149.8
S.E. Equation	0.0	0.0	0.1	1.9
F-statistic	25423.2	2274.0	1.2	11.3
Log Likelihood	289.3	192.2	51.1	–112.6
Akaike AIC	–9.1	–5.8	–1.1	4.3
Schwarz SC	–8.5	–5.2	–0.5	4.9
Mean Dependent	13.9	4.7	0.1	8.8
S.D. Dependent	0.2	0.3	0.1	3.6

Standard errors in ( ) and t-statistics in [].

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Testing the Monthly Calendar Anomaly of Stock Returns in Pakistan: A Stochastic Dominance Approach

ABDUL RASHID and SABA KAUSAR

In this paper, we first examine the presence of monthly calendar anomaly in Pakistan Stock Exchange (PSX) using aggregate and firm-level monthly stock returns. Secondly, we classify the sample firms into low-beta, medium-beta, and high-beta firms to examine the monthly anomaly of stock returns for firms having different level of systematic risk. By considering the stochastic dominance approach (SDA), we employ the simulation based method of Barrett and Donald (2003) to identify the dominant month over the period from January 2000 to December 2017. We find significant evidence of the existence of the January effect in both firm and market stock returns. We also find that the January effect exists more prominently in both low-risk and high-risk firms categorised based on their systematic risk. On the other end of the continuum, for moderately risky firms, there is strong evidence of the presence of the December effect. One of possible explanations of the January effect is the year-end bonus received in the month of January. Such bonuses are generally used to purchase stocks, causing the bullish trend of stock prices in January. However, the evidence of the January anomaly in both low-beta and high-beta portfolios returns is puzzling, suggesting that investors may invest in both low- and high-risk stocks when enthusiastically investing in stock market. The findings of the paper suggest that investors may get abnormal returns by forecasting stock return patterns and designing their investment strategies by taking into account the January and December effects and the level of systematic risk associated with the firms.

JEL Classification: G02, G12, G14

Keywords: Behavioural Finance, Stochastic Dominance Approach, Monthly Anomaly, January Effect, December Effect, TOY Anomaly, Abnormal Returns, KS Type Test, PSX

1. INTRODUCTION

Prior theoretical and empirical studies have documented several calendar anomalies that significantly affect the efficiency of asset markets and the performance of standard asset-pricing models. Among these anomalies, the monthly calendar anomaly is considered one of the well-accepted phenomena and it is observed in several stock markets across the globe. According to Fama and French (1992), stock markets often behave in irrational ways and follow predictable patterns.[1] By examining such patterns

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[1]See Lim and Brooks (2011) for a comprehensive survey on market efficiency.

and trends investors try to get abnormal returns, which leads to anomalies. The January anomaly is perhaps the first anomaly of stock returns, which was discovered by Wachtel (1942). In particular, he found the presence of significant January effect in stock markets of the United States. Since then, several studies have documented different months' effects on stock returns.

It is generally believed that market anomalies are very difficult to predict because they appear, sometimes disappear, and then again reappear [Schwert (1991)]. During the last couple of decades, considerable higher and lower stock returns have generally been observed in several markets across the globe. Yet, the empirical literature is inconclusive at best. On the one hand, some researchers are of the view that despite its popularity over the last many decades, the January phenomenon does not exist anymore in developed stock markets. However, it is also evident in the recent literature that the January effect still exists in several emerging markets as these markets are not yet efficient enough [Patel (2016)].

A monthly anomaly is perhaps the most well publicised anomaly discussed in the literature. Further, the monthly calendar anomaly of stock returns is one of the tenacious calendar anomalies especially, in emerging markets. According to Fama (1998), under and overreaction effects exploit the random walk pattern in stock prices. Lim and Brooks (2011) also scrutinise that stock returns show noticeable pattern and violate efficient market hypothesis (hereafter EMH). Hence, market anomalies either cause inefficiency in stock markets or affect the prediction power of the standard asset-pricing models including the standard capital asset pricing model (henceforth CAPM) and the multifactor asset-pricing models like three-factor and newly developed five-factor models of asset pricing.

Market anomalies are of great interest to individual as well as institutional investors. They often do careful examination of stock price instabilities and abnormal profits. Furthermore, they try hard to find opportunities to get abnormal returns, specifically through seasonal anomalies [Darrat, Li, and Chung (2013)]. Wachtel (1942) was the first, who discovered the January anomaly in US stock market. Later on, other researchers including Keim (1983), Annuar (1987) and Haugen and Jorion (1996) have also documented significant evidence on the January effect on stock returns in the USA. One should also note that there are also several studies that have reported significant evidence of the presence of the January anomaly in stock returns for countries other than the USA [e.g., see Lean, Smyth, and Wong (2007)] for Singapore Stock Market and Alagidede (2013) for Egypt, Nigeria, and Zimbabwe Stock Market). Al-Smadi, Almsafir, and Husni (2017) have also discovered that the returns of January month outperform from the rest of calendar months in Malaysian stock market.

Despite numerous studies on the stock return anomalies, we know little regarding the major factors that drive the monthly anomaly. In contrast to EMH, adaptive market hypothesis (AMH) explains the time varying behaviour of well-known calendar anomalies that might prevail in stock markets [Lo (2004)]. Several researchers have given possible reasons in order to sort out such intricacy. For instance, Fama and French (1993) found that the book-to-market value of firms, window-dressing activities by firms, and momentum patterns are the main causes for the monthly calendar anomaly in stock prices. Similarly, Alagidede (2013) claimed that the fundamental reasons of the existence

of the January effect are the tax-loss-selling hypothesis, the liquidity constraint, and the omitted risk factor. Easterday and Sen (2016) have stated that the potential tax-loss sellers are the ones who significantly derive the January anomaly in stock returns rather than the noise traders. On the other hand, Lynch, Puckett, and Yan (2014) attempted to differentiate the tax-loss-selling hypothesis from the risk-shifting window-dressing hypothesis. Their results are consistent with the window-dressing hypothesis. Li and Gong (2015) have showed the January effect in Japan due to relatively high volatility in the month of January. Rogalski and Tinic (1986) have documented that high-beta stocks yield high returns in January as compared to any other month of the year. Furthermore, Banz (1981), Keim (1983) and Rozeff and Kinney (1976) have found that the January effect is mainly due to small cap stocks. Nevertheless, according to Ligon (1997)**,** the January effect is the result of investors' excessive need of liquidity in the month of January. He has also documented that low real interest and high trading volume lead to higher returns in January. Nonetheless, Rozeff and Kinney (1976) have stated that the risk compensation is the main justification of high returns in the month of January.

Researchers have also documented that instead of January, other months of the year yield significant positive stock returns in some countries. For instance, Mouselli and Al Samman (2016) have confirmed the existence of significant and positive returns in May. Gu (2015) has found the June phenomenon for US stock market. There is also evidence that the month of February is dominated in Iran [Ke, *et al.* (2014)], April is outperformed in US stock market [Wang and Frank (2014)], and the month of August is dominated in Macedonian [Angelovska (2014)]. Further, some other studies documented evidence of the presence of December effect in stock markets of Thailand and GCC countries [Ariss, Rezvanian, and Mehdian (2011); Tangjitprom (2011)].

Reviewing the literature we find that relatively limited studies have been done on calendar anomalies in developing and emerging stock markets. Although, evidence from less developed markets significantly helps explain the mystery of anomalies in stock returns. Further, the limited existing studies on developing markets are even not comprehensive and have used statistical tools that may suffer from several caveats.[2] This motivates scholars to test stock returns anomalies in emerging and developing markets by using more sophisticated and robust statistical methods.

Further, when we review the literature on Pakistan we find that although some scholars have tried to explore the monthly calendar anomaly in Pakistan Stock Exchange (PSX), their focus was very limited and have provided inconclusive findings. For instance, Hashmi (2014), Ullah, Ullah, and Ali (2016), Shamshir and Baig (2016)**,** Jebran and Chen (2017), and Shahid and Sattar (2017) have documented the evidence of the presence of the January effect in PSX. In contrast, Iqbal, Kouser, and Azeem (2013), Shahid and Mehmood (2015), Qureshi and Hunjra (2017) have provided evidence of the non-existence of the January anomaly. However, Shahid and Mehmood (2015) have reported that there are the highest positive

[2]Most of the previous studies, particularly in developing countries, have used OLS, GARCH ARIMA, and ARCH models to test calendar anomalies. The main disadvantage of such techniques is that they follow normal distribution assumption in return distributions. However, the existing studies on Pakistan equity market, for instance, Rashid and Ahmad (2008), have provided evidence that the volatility of stock returns increases with stock returns. Similarly, Khilji and Nabi (1993) have stated that PSX stock returns are leptokurtic and positively skewed. Similarly, Schwert (1991) and Beedles (1979) have also examined that stock returns can be negatively or positively skewed.

returns in March, whereas, significant negative returns are observed in May. Pakistan equity market is an emerging, dynamic, and inefficient market. Thus, it is a highly relevant and interesting case for testing monthly annomalies. Further, there is very limited empirical research on monthly anomalies in PSX, particularly using sophisticated econometric techniques such as stochastic dominance approach. This encourages us to re-examine monthly anomaly in Pakistan equity market.

To fill the above-mentioned gaps, in this paper, we examine monthly calendar anomalies in PSX. We contribute to the existing literature on stock returns anomalies at several levels. First, we explore the monthly calendar anomaly in all listed firms at PSX. Second, we classify the sample firms into low-beta, medium-beta, and high-beta firms to examine monthly anomaly for firms having different level of systematic risk. By doing this, we present first-hand empirical evidence on the monthly anomaly in PSX for firms having different level of systematic risk. Third, and more importantly, unlike most of prior studies, we propose the stochastic dominance (SD) framework to investigate the first, second and, third order of SD. These SD rules are tested by implementing the KS (Kolmogorov-Smirnov) type test of Barrett and Donald (2003) based on SD theory. The main advantage of this test is that it can be useful for examining SD of any-pre-specified order. In addition, it does not require any pre-defined distribution of underlying series. Thus, by applying this test, we present more robust evidence on the presence of monthly calendar anomalies in Pakistan equity market.

We find significant evidence of the existence of the January effect in both firm and market stock returns. We also find that the January effect exists more prominently in both low-risk and high-risk firms categorised based on their systematic risk. On the other end of the spectrum, for moderately risky firms, there is strong evidence of the presence of the December effect. The possible explanation of the January effect is the year-end bonuses received in the month of January. These bonuses are generally used to purchase stocks, causing the bullish trend of stock prices in January. However, the evidence of the January anomaly in both low-beta and high-beta portfolios returns is to some extent puzzling and requires further investigation along these lines. One possible explanation of such finding is that investors invest in both low- and high-risk stocks when enthusiastically investing in stock market, which results in the January effect in both categories of stocks. This finding also provides support for the notion that risk-averse and risk-seeking behaviour simultaneously exists and investors invest in risky stocks with a hope to get higher returns and, at the same time, invest in relatively safe stocks to avoid big losses.

The reminder of the paper is structured as follows. Section 2 first presents the analytical framework and then discusses the empirical methodology and data used in the empirical analysis. Portfolio formulation is also discussed in this section. Section 3 presents the empirical results and their interpretation. Finally, Section 4 presents some concluding remarks and policy implications.

2. EMPIRICAL FRAMEWORK

2.1. Methodology: SD Approach

This study uses the SD approach to test the first three orders of SD. This approach is generally used to test whether one series stochastically dominates the other one at any

specific stochastic order. This paper tests the stochastic dominance of returns of any specific month over other months' returns using the first three SD rules. These rules are the first-order stochastic dominance (hereafter FSD), the second-order stochastic dominance (henceforth SSD), and the third-order stochastic dominance (henceforward TSD).[3]

For an explanation of SD rules, let us assume *A* and *B* are the two investment alternatives with stochastic outcome (say "*r*"*)*. We further assume that this stochastic outcome lies between the range of 0 and 1. We denote the cumulative probability distribution (hereafter CPD) of the outcome of these two investment alternatives by $A(r)$ and $B(r)$, respectively. Regardless of whether investors are risk averse or not, they always attempt to optimise their expected utility of wealth. Therefore, in mathematical expression, asset "*a*", having CDF: $A_a(w)$ stochastically dominates over asset "*b*", having CDF: $B_b(w)$ in case of all non-decreasing utility functions by first order only if the following condition holds.

$$[B_b(w) - A_b(w)] \geq 0 \quad \text{for all level of wealth } (w), \text{ with strict inequality for at least one value of wealth } (w_0) \quad \ldots \quad \ldots \quad (1)$$

Given that the risk aversion is considered as the subset of increasing wealth preference feature of the utility function, SSD assumes that a utility function should not only have a positive marginal utility of wealth but also the total utility of wealth should increase at the decreasing rate. In this context, asset "*a*" stochastically dominates over asset "*b*" by second order if and only if the following condition is satisfied.

$$\int_{\infty}^{w}[F_b(w) - F_a(w)]du \geq 0 \text{ for all level of wealth } (w), \text{ with strict inequality for at least one value of wealth } (w_0) \quad \ldots \quad (2)$$

The third-order SD (TSD) has an additional assumption that investors are risk averse and have a utility function with a feature of decreasing absolute risk aversion. There are sufficient as well as necessary conditions for the existence of TSD. Specifically, for TSD, the existence of SSD is sufficient condition, while the necessary condition for TSD is that the expected mean value of first asset, say "*a*" in our case, should be greater than or at least equal to the expected mean of the other asset, say "*b*" in our case [Hadar and Russell (1969); Levy and Levy (2001); Schmid and Trede (1998)]. Specifically, we define that asset "*a*" dominates over "*b*" by third order of SD if and only if we have the following condition.

$$\int_{\infty}^{\mathrm{w}}\int_{\infty}^{1}[F_b(w) - F_a(w)]\,dudt \geq 0 \text{ for all level of wealth } (w), \text{ with a strict inequality for at least one value of wealth } (w_0) \quad \ldots \quad (3)$$

There exist several tests in the econometric literature that can be used to test the stochastic dominance theory. Examples of these tests include DD test, LMW test, and LSW test given by Davidson and Duclos (2000), the KS type test of stochastic dominance, which is proposed by Barrett and Donald (2003) and Linton, Maasoumi, and

[3]Seyhun (1993) was the first who used the stochastic dominance approach to test the monthly anomaly in NYSE. Later, in order to test the calendar anomaly in Asian countries, Lean, *et al.* (2007) applied the DD test of the stochastic dominance, which is proposed by Davidson and Duclos (2000). However, the orders of stochastic dominance were first proposed by Hadar and Russell (1969).

Whang (2005), and the Improved Bootstrap SD test proposed by Linton, Song, and Whang (2010).

We apply the Kolmogorov-Smirnov (KS) type test of Barrett and Donald (2003).[4] Initially, the KS type test was proposed by McFadden (1989) for FSD. Afterward, Barrett and Donald (2003) proposed the KS type test to test the stochastic dominance of one asset over the other asset. Testing the dominance of one asset over the other in the framework of KS type test is considered superior as compared to running simple OLS regression, ARIMA, or (G)ARCH models. The superiority of this test is mainly attributed to no requirement of any prior knowledge on the distribution of return series. Below we give the brief descriptions of the KS type test. Let $\{A_i\}$, where i = 1, 2, ... , N be *i.i.d* (identical independent distribution) sample of returns to dominated distribution having the $F_A(x)$ cumulative frequency distribution.

By assuming that the CDFs generally lie between [0, x], where $x > 0$ and are continuous functions between the space [0, x], we define the following rules to explain whether the function $D_A^s(x)$ integrates F_X(r) to any stochastic dominance order $s = i$.

$$D_A^1(\mathrm{x}) = F_A(x) \qquad \text{For FSD} \qquad \ldots \quad \ldots \quad \ldots \quad (4)$$

$$D_A^2(\mathrm{x}) = \int_0^x F_A(u)du = \int_0^x D_A^1(u)du \qquad \text{For SSD} \qquad \ldots \quad \ldots \quad \ldots \quad (5)$$

$$D_A^3(\mathrm{x}) = \iint_0^x F_A(v)dvdu = \int_0^x D_A^2(u)du \qquad \text{For TSD} \qquad \ldots \quad \ldots \quad \ldots \quad (6)$$

Similarly, let us suppose $\{B_i\}$, i =1,2,... , *N,* be *i.i.d* sample of returns to non-dominated distribution with CDF of $F_B(x)$. Next, we define the distribution of $D_B^s(x)$ for the function $F_B(x)$ as similar as we have already defined D_A^s(x). Therefore, the test has the following null and alternative hypotheses to test the stochastic dominance order of asset "*A*" over asset "*B*":

H_0^s: $D_A^s(\mathrm{x}) \leq D_B^s(\mathrm{x})$ for all x (stock returns)
H_1^s: $D_A^s(\mathrm{x}) > D_B^s(\mathrm{x})$ for some x (stock returns)

The null hypothesis is stated that asset "*A*" stochastically dominates over asset *"B",* whereas, the alternative hypothesis implies that distribution *B* stochastically dominates over *A.* The following KS type test statistic is applied to test the null hypothesis, H_0^s.

$$K_s = \left(\frac{N^2}{2N}\right)^{1/2} \underset{x}{sup} \left[D_A^{-s}(x) - D_B^{-s}(x)\right] \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

This test can be applied for second (s = 2) or any higher order (s > 2) of stochastic dominance. We obtain the p-values for the underlying null hypothesis through simulation method by estimating the value of suprema of test statistics, K_s [Barrett and Donald (2003)]. Specifically, the following hypothesis could be tested to achieve the objective of our study.

H_0: The underlying target month stochastically dominates over another month at the predefined s^{th}order.

[4]The KS type test is a nonparametric test, which is suitable for testing the equality of one- and two-dimensional, continuous probability distributions. It is named after Kolmogorov (1933) and Smirnov (1948).

2.2. Data and Portfolio Formulation

Monthly stock prices of all publically listed firms and KSE-100 Index are taken from the official website of PSX. We exclude only those firms from the sample that have trading days less than 6 in one month. The study consists of 18-year period ranging from January 2000 to December 2017. Following, Annuar (1987), Fong, Wong, and Lean (2005) and Tangjitprom (2011), stock returns (SR_{it}) are calculated as follows.

$$SR_{it} = ln(\frac{P_{it}}{P_{it-1}}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

where P_{it} denotes stock price of firm *i* at time *t*.

We construct monthly beta (a risk measure) based portfolios of stock returns [Ritter and Chopra (1989)]. Since the risk (beta) associated with the firm may change over time, we calculate the beta for each firm for each month over the sample period. Next, in each month, descending-order ranked firms are categorised as high-beta, medium-beta, and low-beta firms to formulate portfolios based on quartiles. Specifically, top 25 percent firms are considered as high-beta (high-risk) firms, bottom 25 percent firms are classified as low-beta (low-risk) firms, while the middle 50 percent firms are considered as medium-beta (moderately risky) firms.

3. EMPIRICAL RESULTS

We start our empirical analysis by presenting summary statistics. Next, we examine the presence of monthly anomaly using the stock returns of publically listed firms included in our sample. After presenting the evidence on the existence of monthly anomaly in stock returns for full sample, we construct the three beta-based portfolios and examine the presence of monthly anomaly in constructed portfolios' returns. Finally, we present the results on the month effect in overall Pakistan equity market using KSE-100 Index as a proxy for overall stock market performance. We do so, as one of the aims of our study is also to check the presence of monthly anomaly in overall Pakistan equity market.

3.1. Descriptive Statistics

Before testing the presence of monthly anomaly, we present month vice descriptive statistics for all sample firms, beta-based portfolios, and KSE-100 Index returns. Table 1 displays the summary statistics. The table provides several notable stylised facts. Specifically, it displays that most of months' stock returns are positive and show rising trend over the examined period. One can clearly observe from the statistics presented in the table that the mean returns are higher in the month of January (3.832 percent) as compared to the other months of the year. In contrast, October has the lowest stock returns (indeed negative) with the magnitude of –0.065 percent.

These observations are consistent with the results for developed markets. Several existing empirical studies have also documented that the month of January yields high returns, on average, as compared to the other months of the year. Examples of these studies include Agrawal and Tandon (1994), Boudreaux (1995), Gultekin and Gultekin (1983), and Haugen and Jorion (1996). Similarly, the median stock returns (1.359 percent) are also high in January as compared to any other month of the year. Looking at the value of standard deviation presented in the table, we observe that the estimated value

of standard deviation of returns for the month of January is 23.887 percent, which is high as compared to that of other months. Thus, the table provides evidence that in January, not only the stock returns are high but also there is more variation in stock returns. This observation is consistent with the standard finance theory which states that higher expected returns are always associated with higher risks. Some other researchers have also confirmed the high-risk-high-return relationship [Ghysels, Santa-Clara, and Valkanov (2005)]. The statistics also suggest that the stock returns may not be normally distributed. Specifically, we observe that returns are negatively skewed in 4 out of 12 months. In sum, skewness and kurtosis values suggest non-normality in stock returns over the examined period, which motivates us to apply the stochastic dominance approach to test monthly anomaly in Pakistan equity market.

Table 1

Summary Statistics of All Listed Firms

Months	Jan-uary	Feb-ruary	March	April	May	June	July	August	Septem-ber	Octo-ber	Novem-ber	Decem-ber
Mean	3.832	2.418	-1.366	2.668	-0.641	-0.976	0.624	-1.550	0.319	-0.065	0.803	2.717
Median	1.359	-0.077	-0.581	0.662	-0.293	-0.654	0.218	-0.606	-1.338	-0.247	0.008	1.356
Standard Deviation	23.887	18.960	18.117	19.092	19.017	18.312	16.586	17.309	17.737	17.212	17.157	21.530
Kurtosis	26.430	109.063	30.017	21.579	18.457	20.207	34.510	76.302	48.850	19.150	27.285	18.486
Skewness	-0.052	5.397	0.911	-0.268	0.729	0.783	0.574	-3.084	2.310	-0.095	1.484	0.315
No. of Observation	5455	5288	5395	5680	5555	5581	5560	5030	5438	5502	4411	5249

Table 2 presents average returns and standard deviation of KSE-100 Index and beta-based portfolio returns. We divide the table into four panels. The first panel is labelled as "Low-Beta Portfolio", the second is named as "Medium-Beta Portfolio", the third panel is labelled as "High-Beta Portfolio" and the final panel is denoted as "Market Portfolio". We find that high-beta portfolio, low-beta portfolio, and market portfolio, on average, yield higher returns in the month of January, having values of 9.466 percent, 4.625 percent, and 1.161 percent, respectively. Based on this preliminary evidence we can say that the stock returns of high-beta portfolio, low-beta portfolio, and market portfolio may outperform in January as compared to the non-January months. In contrast,

Table 2

Summary Statistics of Beta-based and Market Portfolio

	Beta-Based Portfolios											
	High-Beta Portfolio			Medium-Beta Portfolio			Low-Beta Portfolio			Market Portfolio		
Months	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD	Obs.
January	9.466	(28.868)	1405	0.454	(18.470)	2669	4.625	(26.319)	1381	1.161	(1.352)	18
February	4.459	(27.596)	1314	1.226	(14.086)	2637	2.760	(16.605)	1337	0.349	(0.945)	18
March	-0.740	(21.217)	1372	-2.247	(14.123)	2669	-0.263	(21.351)	1354	0.163	(1.361)	18
April	3.985	(22.366)	1436	2.182	(16.113)	2819	2.304	(20.820)	1425	0.244	(1.025)	18
May	2.657	(21.794)	1408	-3.094	(13.896)	2758	0.875	(23.596)	1389	0.089	(1.067)	18
June	-1.174	(22.717)	1424	-2.265	(12.891)	2762	1.779	(21.804)	1395	0.427	(1.718)	18
July	0.743	(19.947)	1420	0.989	(12.692)	2715	-0.189	(19.222)	1425	0.494	(0.824)	18
August	-1.145	(23.329)	1276	-1.350	(13.380)	2489	-2.352	(17.022)	1265	0.125	(1.354)	18
September	-0.059	(19.080)	1390	0.550	(12.787)	2688	0.248	(23.727)	1360	0.191	(0.722)	18
October	0.677	(19.494)	1401	0.024	(14.657)	2709	-0.989	(19.220)	1392	0.382	(0.847)	18
November	2.278	(21.092)	1125	-0.232	(13.177)	2162	1.319	(19.288)	1124	0.061	(1.162)	18
December	1.422	(26.892)	1350	2.555	(16.495)	2569	4.344	(23.796)	1330	0.128	(1.068)	18

we observe that in medium-beta portfolio, the average returns of December (2.555 percent) are higher than the portfolio returns for other months. Thus, we expect that the month of December may outperform in case of medium-beta portfolio. The mean values of beta-based portfolio returns provide a clue for the presence of the January and December effect in PSX: a theme, which we explored in this study.

We further observe that in both high-beta and low-beta portfolios, stock returns as well as their standard deviations are high in January. However, in the portfolio of medium-beta firms, the returns are high in the month of December (2.555 percent), whereas, the standard deviation of returns is high in the month of January with the value of 18.470 percent. Similarly, in case of market portfolio, average returns are high in January having the value of 1.161 percent.

We test normality of stock returns by applying Kolmogorov-Smirnov test of normality. The results provide evidence that month vice returns for full sample and beta-based portfolios are not normally distributed. However, the monthly returns of KSE-100 Index are normally distributed. This evidence suggests that the stochastic dominance (SD) approach is the appropriate technique to test the monthly calendar anomalies in PSX.

3.2. The January Effect in Firms' Stock Returns

In this subsection, we examine the January effect. For this purpose, we test the SD of January returns and the returns of other calendar months. As Table 1 shows, on average, the returns of January are higher than that of non-January months. Therefore, we examine the SD of January over all remaining calendar months. First, CDF is used to examine the visual dominancy. Next, we apply formal test to check SD of the underlying month over the other months. CDF presents the comparison between the two underlying distributions. Analysis of the graph gives a clue of SD.

Figure 1 shows the CDFs of four months that are selected based on higher stock returns. From Table 1, we examine that the top four months on the basis of their returns are January (3.832 percent), December (2.717 percent), April (2.668 percent), and February (2.418 percent). Therefore, we present the CDFs of only these four months. The remaining months' CDFs are omitted to reduce clutter. On the whole, the CDF of January and December lie to the right side of the other CDFs, implying that returns in January or December are expected to outperform over the remaining calendar months. To proceed further, the formal test of stochastic dominance is used to examine which of the month stochastically dominates over the other months.

Table 3 presents the results of SD test for the month of January with respect to other months. The table has two parts. In first part, named as "January *versus* other months", the p-values for testing the null hypothesis that $H_0: X >_s Y$, that is, the target month stochastically dominates over non-target months at s^{th} order, are given. The second panel shows the p-values for the reverse hypothesis, $H_1: Y >_s X$, that is, the non-target month SD dominates over target month. The SD1, SD2, and SD3 denote SD at order first, second, and third, respectively. The p-values presented in the first part of the table show that the month of January is stochastically dominating over other calendar months.

Fig. 1. CDFs of Returns of All Listed Firms

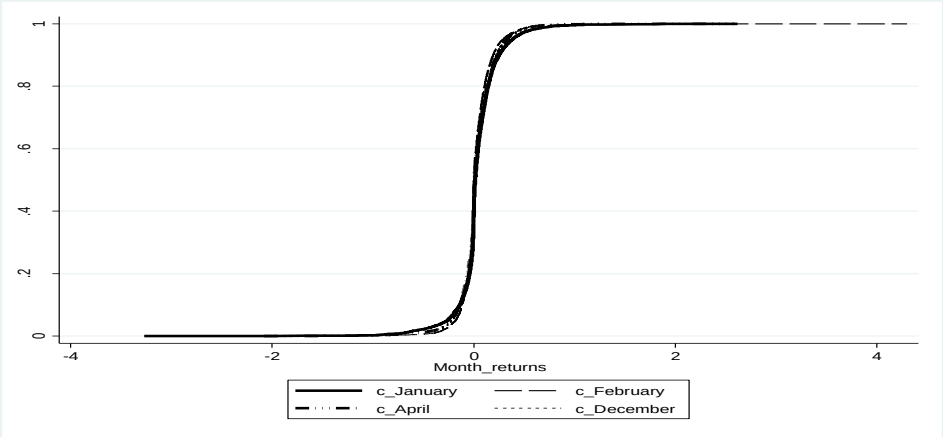


Table 3

Test Results for January Month; Sample: All Listed Firms

	January *versus* other Month			Other Month *versus* January		
	KS P-value					
Months	SD1	SD2	SD3	SD1	SD2	SD3
January	**Winner**					
February	0.007	0.000	0.253	0.000	0.000	0.000
March	0.592	0.032	0.295	0.000	0.000	0.000
April	0.278	0.004	0.248	0.000	0.000	0.001
May	0.183	0.003	0.229	0.000	0.000	0.000
June	0.382	0.018	0.282	0.000	0.000	0.000
July	0.121	0.000	0.212	0.000	0.000	0.000
August	0.253	0.017	0.350	0.000	0.000	0.000
September	0.097	0.000	0.158	0.000	0.000	0.000
October	0.481	0.022	0.243	0.000	0.000	0.000
November	0.155	0.001	0.188	0.000	0.000	0.000
December	0.653	0.398	0.385	0.000	0.000	0.000

Note: This table presents the results for the stochastic dominance of January in all publicly listed firms included in the sample. The number of comparison between any two calendar months is C(12,2)=66. Winner month "January" months' results are presented only. The first panel namely January *versus* other months tests the null hypothesis that the month of January dominates over other calendar months. The SD1, SD2, and SD3 are the stochastic dominance orders. The p-values are calculated through the simulation method proposed by Barrett and Donald (2003).

Put differently, we do not reject the null hypothesis that the target month (January) dominates over the non-target month, as the p-values for the first and third order of SD are greater than any acceptable level of significance except for the SD1 of February, where it is 0.007. This implies that the month of January is strongly dominating over other calendar months in first and third SD orders. However, the p-values of SD2 show that January is weakly dominating over all non-January months at the second order of SD except the month of December.

Overall, the results suggest that January strongly dominates over non-January months at all three order of stochastic dominance during the examined period.

3.3. The January Effect in Low-Beta and High-Beta Portfolio

In this subsection, we examine the January effect in high-beta and low-beta portfolios. We do so, because the descriptive statistics presented in Table 2 clearly suggest that the mean returns of January are high from the mean returns of the rest of months in case of both high- and low-beta portfolios. Furthermore, Figures 2 and 3 demonstrate the CDFs of returns for those months that have relatively higher returns in both high- and low-beta portfolios. In particular, the CDFs of the top four months ranked based on the mean values of stock returns are presented in the figure and the CDFs of returns of the other months are not presented in order to avoid the clutter in the figure.

Table 2 shows that in high-beta portfolio, on average, the highest returns are for the month of January with a value of 9.466 percent. The mean returns of the months of February (4.459 percent), April (3.985 percent), and May (2.657 percent) are at second, third, and fourth position, respectively. The CDFs of January and February are the most right. This implies that both January and February seem to dominate over the rest of months of the year. In contrast, the CDF of April month and the CDF of May are most left side. Thus, Figure 2 clearly indicates that in case of high-beta portfolio, the month of January or February may dominate over other months, at certain SD orders.

Fig. 2. The CDFs of Monthly Returns of High Beta Portfolio

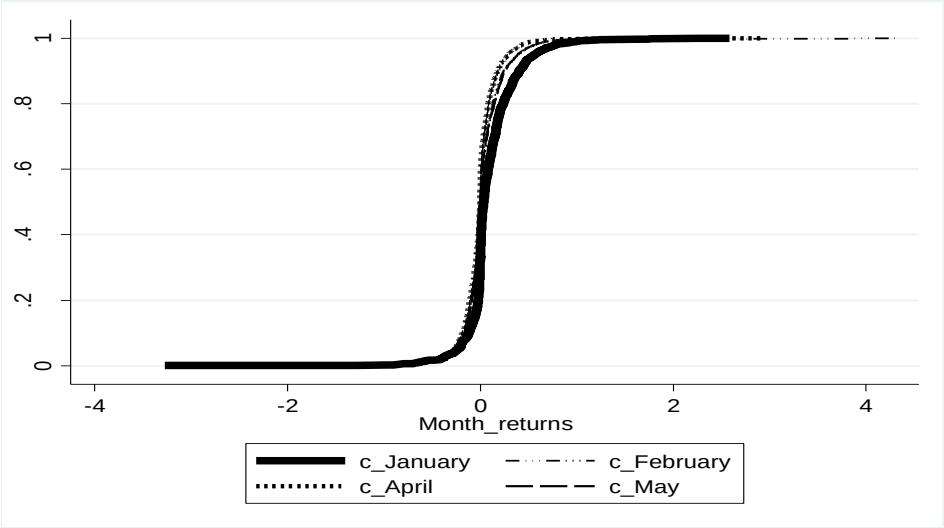
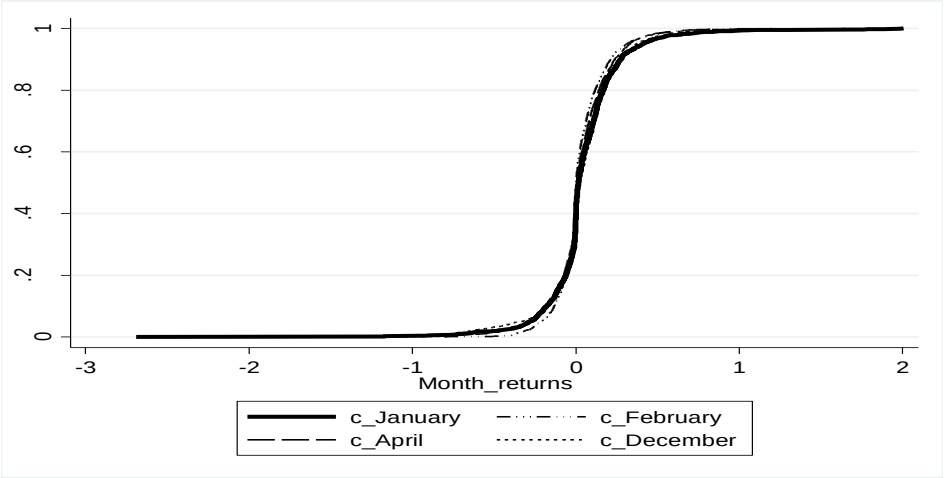


Figure 3 shows the top four months' CDF of returns for low-beta portfolios. These months are January with the average returns of 4.625 percent, December with the mean returns of 4.344 percent, February having the mean return of 2.760 percent, and April with the mean returns of 2.304 percent. We can observe from the figure that the CDF curves of the month of January and December appear on the right side as compared to the remaining months' CDFs. Thus, we predict that there may be the January or December

anomaly in low-beta portfolio returns. Therefore, similar to the case of high-beta portfolio, we consider January as a "winner" month in low-beta portfolio and formally test the dominance of the month of January by applying SD approach. In sum, Figure 2 and Figure 3 exhibit the dominance of January or February over other calendar months in high-beta portfolio and January or December in low-beta portfolio returns. We now formally test the presence of the monthly anomaly in beta-based constructed portfolios returns. First, we test the SD of January *versus* the non-January months.

Fig. 3. The CDFs of Monthly Returns of Low-Beta Based Portfolio



In order to confirm this preliminary observation, we apply the formal test of SD by considering January as a "winner" month. The estimated p-values for testing the stochastic dominance order are given in Table 4. We first divide the table into three main columns labelled as "High, Medium, and Low Beta Portfolios", and then each portion is further divided into two sub-panels: "January *versus* other Month", and "Other Month *versus* January". The estimated p-values of the KS type test for SD1, SD2, and SD3 are presented. The sub-panel labelled as "January *versus* other Month" states the null hypothesis that the month of January stochastically dominates over other month. On the other hand, the second sub-panel labelled as "other month *versus* January" tests the opposite hypothesis, that is, the underlying month stochastically dominates over January. For low-beta and high-beta portfolios, the p-values given in the panel "January *versus* other month" are in favour of not rejecting the null hypothesis for the all three SD orders tested in this study. This implies that the month of January dominates over other months in both high-beta and low-beta portfolios at the first, second, and third order of SD. The p-values presented in panel "Other month *versus* January" confirm the dominance of January in both portfolios.

To observe whether the January effect strongly or weakly exists, we do a comparison of the p-values for the null hypothesis with the p-values of the reverse null hypothesis. By comparing the p-values for the case of high-beta portfolios, we examine that the month of January strongly dominates over the remaining months of the year at all the three examined orders of SD.

Table 4

SD Tests for Beta-Based Constructed Portfolio: January versus Non-January Months

	High Beta Portfolio						Medium Beta Portfolio						Low Beta Portfolio					
	January *versus* Other Months			Other months *versus* January			January *versus* Other Months			Other Months *versus* January			January *versus* Other Months			Other Months *versus* January		
	KS P-value																	
Months	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3
January		**Winner**															**Winner**	
February	0.694	0.303	0.453	0.000	0.000	0.000	0.039	0.000	0.000	0.000	0.705	0.667	0.133	0.008	0.175	0.000	0.002	0.040
March	0.969	0.521	0.442	0.000	0.000	0.000	0.195	0.000	0.063	0.000	0.000	0.000	0.977	0.520	0.431	0.000	0.000	0.000
April	0.702	0.500	0.432	0.000	0.000	0.000	0.019	0.000	0.000	0.048	0.710	0.674	0.884	0.355	0.438	0.002	0.000	0.000
May	0.851	0.415	0.440	0.000	0.000	0.000	0.099	0.000	0.001	0.000	0.000	0.000	0.915	0.385	0.404	0.000	0.000	0.000
June	0.980	0.518	0.433	0.000	0.000	0.000	0.044	0.000	0.001	0.000	0.000	0.000	0.882	0.389	0.395	0.000	0.000	0.000
July	0.939	0.363	0.402	0.000	0.000	0.000	0.016	0.000	0.000	0.000	0.706	0.671	0.759	0.276	0.401	0.000	0.000	0.000
August	0.996	0.736	0.696	0.000	0.000	0.000	0.085	0.000	0.000	0.000	0.000	0.000	0.870	0.289	0.372	0.000	0.000	0.000
September	0.872	0.283	0.363	0.000	0.000	0.000	0.007	0.000	0.016	0.000	0.566	0.674	0.748	0.115	0.283	0.000	0.000	0.000
October	0.956	0.522	0.456	0.000	0.000	0.000	0.155	0.000	0.054	0.000	0.020	0.325	0.980	0.482	0.403	0.000	0.000	0.000
November	0.944	0.456	0.413	0.000	0.000	0.000	0.077	0.000	0.019	0.000	0.000	0.160	0.769	0.160	0.329	0.000	0.000	0.000
December	0.999	0.526	0.451	0.000	0.000	0.000	0.022	0.000	0.000	0.023	0.711	0.659	0.748	0.115	0.283	0.633	0.408	0.678

Note: For each constructed portfolio, the number of comparison between any two calendar months is C(12,2) = 66. The results for only winner month "January" are presented. The first panel namely January *versus* other months tests the null hypothesis that the month of January dominates over other calendar months. The SD1, SD2, and SD3 are the stochastic dominance orders. The p-values are calculated through the simulation method proposed by Barrett and Donald (2003).

The p-values suggest that in low-beta portfolio, the month of January strongly outperforms in all the three examined orders over the other months except December, where it weakly dominates. More specifically, the month of January weakly dominates over December at the SD2 and SD3 stochastic order. Yet, January strongly dominates over December at the first stochastic order as the p-value for January is 0.748, whereas, the corresponding figure for December is 0.633. In short, in low-beta portfolio, January strongly dominates over the rest of the months except the month of December at all the three examined SD orders, although it weakly dominates over December at the second and third order of SD.

These results support the findings of many earlier studies for many emerging and developed studies. For instance, Li and Gong (2015) have found that the January anomaly in Japan. Likewise, Wong, Neoh, Lee, and Thong (1990) and Haugen and Jorion (1996) have also documented the presence of the January anomaly in New York Stock Market. Wong, *et al.* (1990) examined the January phenomenon in Malaysia Stock Market. Our results are also in favour of Keim (1983), who has documented that the January anomaly is higher for small-sized (generally considered as risky) firms than large-sized (commonly viewed as less risky) firms. Similarly, Sum (2010) found that the January effect is high, particularly in the small-cap portfolio.

Turning to the result for medium-beta portfolio, given in "January *versus* Other Month" panel, we observe that January does not stochastically dominate over the other calendar months of the year at either examined SD order. The reported p-values are either zero or considerably less than any commonly acceptable level of significance, providing strong evidence of the rejection of the null hypothesis.

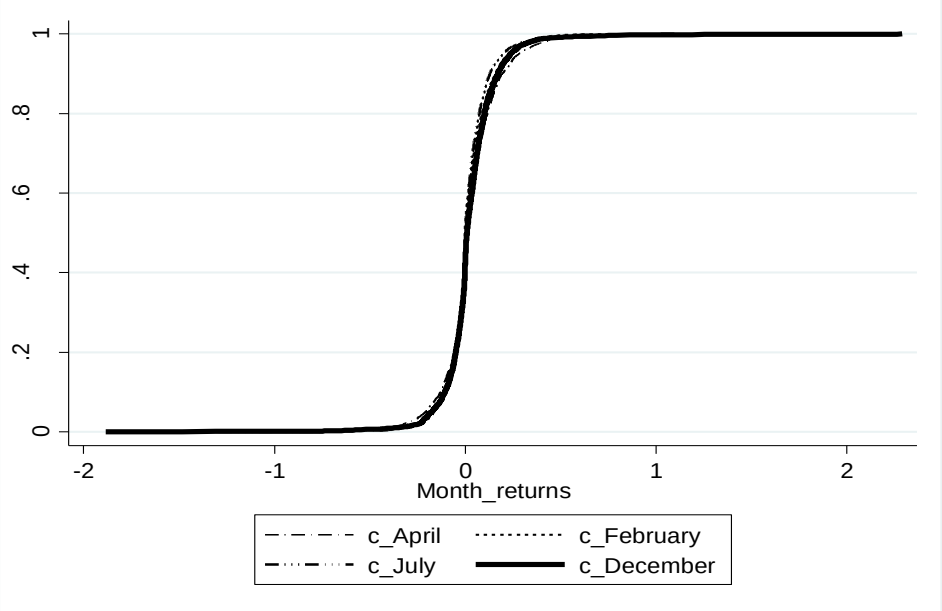
When we look at the p-values for the reverse null hypothesis, we find that in most of the cases, the null hypothesis is rejected at any acceptable level of significance. We find that for the case of first order of SD, the null hypothesis is rejected for all months except December and April. For the second order of SD, for 6 out of 11 months, the p-values provide evidence of the rejection of the constructed null hypothesis, that is, January dominates over the other months. Finally, for the third order of SD, we find

evidence in favour of the rejection of the null hypothesis for 4 months. However, one should note that the null hypothesis that December stochastically dominates over January is not rejected at either examined stochastic dominance order. This suggests that December stochastically outperforms over January in case of medium-beta portfolio. This finding is in agreement with the information provided by the CDFs presented in Figure 3. This motivates us to test the stochastic dominance of December over other calendar months in the next sub-section.

3.4. Exploring the December Effect in Medium-Beta Portfolio

In this sub-section, we investigate the December effect in returns of medium-beta portfolio. The descriptive statistics presented in Table 2 suggest that in medium-beta portfolio, on average, the returns in December (2.555 percent) are higher as compared to the remaining calendar months. Before applying the formal test for testing the stochastic dominance of the month of December, we present the CDFs of top four months ranked based on average returns. Figure 4 shows the CDFs of monthly returns of medium-beta portfolio for the top four months ranked based on their average returns over the examined period. These four months are December, April, February, and July. By doing a thorough assessment of the CDFs, we observe that the CDF of December appears on the most right side with the return of 2.555 percent and the CDF of April appears at the second position with returns of 2.182 percent. Thus, the CDFs suggest the likelihood of the presence of either the December or April effect in medium-beta portfolio returns.

Fig. 4. The CDFs of the Monthly Returns of Medium-Beta Portfolio



The p-values of the KS tests are presented in Table 5 for testing the SD of December. Note that the remaining attributes in Table 5 are similar to those in Table 4.

With regard to medium-beta portfolio, we find some striking results. Specifically, we find that the returns of December outperform over all remaining calendar months' returns at all the three examined SD orders. The p-values for the null hypothesis: December *versus* other months is considerably greater than the acceptable level of significance, suggesting that the null hypothesis is not rejected at the given level of significance. On the opposite side, the p-values of the null hypothesis of other months *versus* December are nearly zero in all calendar months except for April. Thus, we can conclude that December stochastically dominates over the other months of the year at all the three examined SD orders in case of medium-beta portfolio. However, we also find that April weakly dominates over December at all the three SD orders having p-values 0.032, 0.019, and 0.108, respectively. In contrast, the p-values for December are 0.0714, 0.565, and 0.510, respectively, which indicate that December is strongly dominating over the month of April.

Turning to the results for high beta and low beta portfolios, we also observe some interesting evidence. For example, in case of high-beta portfolio, the reported p-values for null hypothesis of December *versus* other month provide evidence in favour of the rejection of the null hypothesis. These results suggest that December does not stochastically dominate over other calendar months at either examined stochastic dominance order. In general, these results are confirmed by the p-values reported for the reverse null hypothesis that other month stochastically dominates over December. Yet, one should note that in some cases, the month of December stochastically dominates over the other months. For example, December stochastically dominates over June, in particular, at the first, second and the third stochastic order. Similarly, December stochastically dominates over March and July, although at only the third stochastic dominance order. It can also be observed from the table that in high-beta portfolio, the eight months namely January, February, April, May, July, September, October, and November appear to dominate stochastically over December.

For low-beta portfolio, we observe that December stochastically dominates over all other calendar months except the month of January. This evidence holds for all three examined stochastic dominance orders. Taking together the results presented in Table 4 and Table 5, we come to the conclusion based on the reported p-values that for medium-beta portfolio, the month of December is dominating over all the other calendar months, and for high-beta and low-beta portfolios, the month of January is dominating. Our results are consistent with the results of Sum (2013). The stochastic dominance of both January and December may suggest the existence of another anomaly called the turn-of-the-year (hereafter TOY) effect.[5] This evidence is in line with the several prior existing studies including Sikes (2014), Tangjitprom (2011), Ritter and Chopra (1989), and Lakonishok and Smidt (1984). However, to arrive at the final conclusion whether the TOY effect is really present in Pakistan equity market, one should formally test the phenomenon.[6]

[5]TOY effect implies that returns are high during the month of December and January as compared to the other months.

[6]We did not do so because our focus is testing the January and December effects separately.

Table 5

SD Tests for December Month with Respect to other Month

	High Beta Portfolio						Medium Beta Portfolio						Low Beta Portfolio					
	December *versus* Other Months			Other Months *versus* December			December *versus* Other Months			Other Months *versus* December			December *versus* Other Months			Other Months *versus* December		
	KS P-value																	
Months	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3	SD1	SD2	SD3
January	0.000	0.000	0.000	0.999	0.526	0.451	0.023	0.711	0.659	0.022	0.000	0.000	0.633	0.408	0.678	0.748	0.115	0.283
February	0.000	0.000	0.000	0.000	0.717	0.670	0.857	0.610	0.527	0.000	0.000	0.000	0.129	0.002	0.152	0.000	0.004	0.061
March	0.020	0.000	0.255	0.000	0.000	0.001	0.998	0.543	0.478	0.000	0.000	0.000	0.812	0.401	0.548	0.000	0.000	0.000
April	0.000	0.000	0.000	0.041	0.693	0.631	0.0714	0.565	0.510	0.032	0.019	0.108	0.505	0.177	0.487	0.000	0.000	0.000
May	0.000	0.000	0.000	0.000	0.655	0.558	0.987	0.490	0.467	0.000	0.000	0.000	0.489	0.220	0.463	0.000	0.000	0.000
June	0.200	0.012	0.282	0.000	0.000	0.000	0.926	0.284	0.401	0.000	0.000	0.000	0.631	0.269	0.460	0.000	0.000	0.000
July	0.007	0.000	0.166	0.000	0.105	0.423	0.763	0.254	0.402	0.000	0.000	0.000	0.459	0.126	0.450	0.000	0.000	0.000
August	0.013	0.000	0.435	0.000	0.000	0.000	0.955	0.439	0.581	0.000	0.000	0.000	0.518	0.121	0.397	0.000	0.000	0.000
September	0.008	0.000	0.113	0.000	0.002	0.056	0.538	0.061	0.373	0.000	0.000	0.000	0.576	0.270	0.684	0.000	0.000	0.000
October	0.009	0.000	0.040	0.000	0.092	0.539	0.996	0.480	0.434	0.000	0.000	0.000	0.695	0.319	0.496	0.000	0.000	0.000
November	0.001	0.000	0.007	0.000	0.704	0.667	0.970	0.448	0.429	0.000	0.000	0.000	0.319	0.074	0.320	0.000	0.000	0.000
December	**Winner**																	

Note: For each constructed portfolio, the number of comparison between any two calendar months is C(12,2) = 66. The results for only winner month "December" are presented. The first panel namely December *versus* other months tests the null hypothesis that the month of December dominates over other calendar months. The SD1, SD2, and SD3 are the stochastic dominance orders. The p-values are calculated through the simulation method proposed by Barrett and Donald (2003).

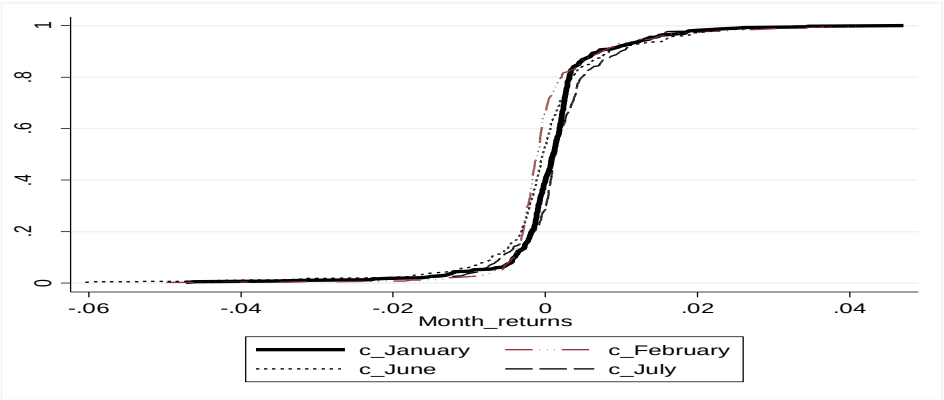
3.5. The January Effect in KSE-100 Index Returns

After presenting the strong evidence of monthly anomaly in firm stock returns as well as in stock returns of portfolios constructed based on the level of systemic risk, we present results for the January effect in overall Pakistan Stock Exchange (PSX).

Similar to other cases, we start by constructing CDFs. Figure 5 presents the CDFs of the top four months' KSE-100 Index returns, namely, January (1.161 percent), July (0.494 percent), June (0.427 percent), and February (0.349 percent). The figure shows that the CDF of January and July are to the most right. The graph clearly gives an indication of the January or July effect in equity market of Pakistan.

Table 6 presents the p-values of KS test for monthly returns of KSE-100 Index. In the fists panel, the p-values for the null hypothesis that January stochastically dominates over other months at the first order (SD1), the second order (SD2), and the third stochastic order (SD3) are presented. Similarly, in the second panel, the p-values for the reverse null hypothesis are presented.

Fig. 5. The CDFs of Monthly Returns of KSE-100 Index



Comparing the p-values of January with other months, we observe that the month of January strongly dominates over rest of the months. In particular, the p-values reported in the first panel of the table are considerably greater than any acceptable level of significance for all the examined stochastic dominance orders. This result suggests that the null hypothesis that the month January stochastically dominates over the other calendar months is not rejected at any acceptable level of significance. The dominance of January over other months is generally confirmed by the p-values in the second panel of the table for testing the reverse null hypothesis.

Nevertheless, we find February weakly dominates over January at the second order of SD. For instance, the p-values for January *versus* February for the SD1, SD2, and SD3 of SD orders are 0.789, 0.245, and 0.366, respectively. On the other hand, the p-values for February *versus* January are 0.000, 0.013, and 0.003, respectively, showing a strong dominance of January over February at the first and third order and weak dominance of February over January at the second order of stochastic dominance.

Table 6

Stochastic Dominance of January Month in KSE-100 Index Returns

	January *versus* Other Month			Other Month *versus* January		
	KS P-value					
Months	SD1	SD2	SD3	SD1	SD2	SD3
January	**Winner**					
February	0.789	0.245	0.366	0.000	0.013	0.003
March	0.726	0.533	0.489	0.000	0.000	0.000
April	0.000	0.022	0.029	0.000	0.000	0.000
May	0.974	0.455	0.471	0.000	0.000	0.000
June	0.797	0.723	0.683	0.000	0.002	0.000
July	0.001	0.069	0.036	0.000	0.000	0.000
August	0.976	0.552	0.462	0.000	0.000	0.000
September	0.926	0.288	0.359	0.000	0.000	0.000
October	0.537	0.256	0.353	0.000	0.004	0.003
November	0.936	0.347	0.367	0.000	0.000	0.000
December	0.000	0.060	0.341	0.008	0.000	0.000

Note: This table presents the results for the stochastic dominance of January in KSE-100 Index returns. The number of comparison between any two calendar months is C(12,2)=66. Winner month "January" months' results are presented only. The first panel namely January *versus* other months tests the null hypothesis that the month of January dominates over other calendar months. The SD1, SD2, and SD3 are the stochastic dominance orders. The p-values are calculated through the simulation method proposed by Barrett and Donald (2003).

The results given in Table 6 are consistent with the findings of Boudreaux (1995) for Denmark, Germany, and Norway Stock Markets, Haugen and Jorion (1996) and Haug and Hirschey (2006) for US market, Annuar (1987) for Kuala Lumpur Stock Market, Fountas and Segredakis (2002) for selected emerging market , Lean, *et al.* (2007) for Asian stock markets, and Li and Gong (2015) for Japanese equity market.

The main reasons of the January effect can be liquidity constraint, tax-loss-selling hypothesis, and omitted risk factor. Some researchers have attributed the tax-loss-selling

hypothesis as the main reason for the presence of the January effect in stock returns. For example, Branch (1977) and Wachtel (1942) explaining the large January returns argue that the year-end tax loss selling is one of the major causes of the January anomaly. The main explanation of the January effect is that individuals are likely to sell losing stocks at the end of the year to realise capital losses to avoid tax payments and repurchase them again in the month of January. Our analysis suggests that this effect appears more prominent in case of both low-risk and high-risk firms. However, for moderately risky firms, we show the presence of the December effect in stock returns.

4. CONCLUSIONS

In this study, we test monthly anomaly in Pakistan Stock Exchange. For this, we test the January effect for all publicly listed firms, beta-based portfolios, and KSE-100 Index returns by using stochastic dominance (SD) theory. By applying the KS type test of SD, we find substantial evidence of the existence of the January effect in our sample of listed firms as well as in equity market index returns. We also find that the January effect exists in both high-beta and low-beta portfolios. In contrast, the December effect exists in low-beta portfolio. The possible explanation of these results is the year-end bonuses received in January. These bonuses are generally used to purchase stocks, causing the bullish trend of stock prices in January, [Al-Saad and Moosa (2005); Shao and Hur (2016); Sun and Tong (2010)]. The size effect explains that small cap stocks outperform in the month of January [Banz (1981); Keim (1983); Rozeff and Kinney (1976)]. Furthermore, high beta stocks are more traded in January and may result in high returns [Rogalski and Tinic (1986)]. The movements in bid-ask spread can also be one of the reasons of high returns in January [Lakonishok and Smidt (1984); Ligon (1997)].

Our results have several important implications for different participants of stock market such as firms, money, and mutual fund managers, investors, academicians, researchers, and policy-makers. Our results suggest that investors may get abnormal returns by forecasting stock returns patterns and designing their investment strategies by taking into account the January and December effects. Our findings are also of significance to portfolio managers in order to get portfolio diversifications. Based on the findings we present here, we suggest that Security and Exchange Commission of Pakistan should instruct the firms to explicitly report sufficient and necessary information in their financial reports, which lessens information asymmetries and in turn, helps in improving market efficiency. We test the monthly anomaly at PSX firms on the basis of systemic risk firms. However, our study can be extended by examining the monthly calendar anomalies based on other firm-specific characteristics such firm size, growth, the market value of firms, the level of leverage, etc. Moreover, testing calendar anomalies in commodity or derivative market can also help enhance our understanding of market anomalies.

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Book Review

Fareeha Zafar. *Canals, Colonies and Class: British Policy in the Punjab 1880-1940*. Lahore, Pakistan: Lahore School of Economics. 2017. xxii + 317 pages. Price not given.

Fareeha Zafar's book *Canals, Colonies and Class: British Policy in the Punjab 1880-1940* is essentially an edited reproduction of her PhD thesis, *The Impact of Canal Construction on the Rural Structures of the Punjab: The Canal Colony Districts, 1880 To 1940*. The thesis was completed about 35 years ago at the School of Oriental and African Studies, the University of London (now SOAS, the University of London). She studies the British colonisation process in the Punjab and its effect on the local environment, the production patterns, and social relations, understanding that despite several similar studies on the region, no serious effort had been made to synthesise these issues the way she does in this book. However, in the form of a new book, the synthesis does not add much value as it reiterates the British colonisers' well-known strategies, namely irrigation development as a tool to settle disarmed forces and nomads and, thereby, strengthening a class of local landed elite to maintain their power in the colonies, their revenue-seeking policies, indebtedness of the landed class and alike. Nevertheless, considering the timing of the original contribution, the book, if read together with the contributions such as Khuhro (1978/1999) and Cheesman (1997), provides a relatively rich description of geographers' analyses of the British policies, their intentions, and their effects.

Organised into nine chapters, the book starts with a brief introduction, followed by three chapters highlighting the changes in the physical landscape in the form of ecology, human settlements and the population patterns, changes in the cropping patterns, production levels, and other agricultural developments. The subsequent three chapters deal with the emergence of a new land market, the class structure, and the changes in the land-tenure systems. Chapter eight puts these pieces together to highlight the social change triggered by the coloniser's irrigation and allied policies and their effect on the rural society, the land ownership patterns, and the class structure of the society. The conclusion basically provides a chapter-wise summary, but it also goes on to show the way differential access to the irrigation technology led to specific production relations in the twentieth-century Punjab and helped the colonisers in class formation to enhance and prolong their rule in South Asia.

At least four comments can be made on the book. Firstly, it is unclear why Zafar published a three-decade old work as a new book without any value addition, such as a reanalysis of the issues and thoughts expressed in the original contribution. Secondly, the book—as also noted by Savage (2001) about similar works produced by the history scholars of the era—also fails to appreciate the role of local cultural and religious elites and the institutions, and implicitly portrays locals as passive recipients of the change

initiated by the colonisers. Thirdly, a reader already informed on the subject may feel disappointed as the promise to provide a rich synthesis, which Zafar claims to be missing from earlier contributions, still remains largely unfulfilled. In fact, compared with the contributions of Cheesman (1997) and Khuhro (1978/99), her contribution is more descriptive and less analytical. Finally, the book remains largely disconnected from the changing international political landscape during the 1930s and the 1940s, which later determined the fate of many colonies and colonisers. It is largely unknown how it affected the British policies during those years.

Having said that, Zafar's thesis is now more accessible and may amuse new readers who want to know this historical account of the British rule in India. Various historical events mentioned in the main text, footnotes, and annexes were unreported in the past. The book and resource materials it mentions are indeed a valuable contribution that may guide future researchers towards grey literature available on the subject.

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Shorter Notice

Austin Williams. *China's Urban Revolution: Understanding Chinese Eco-Cities*. London and New York: Bloomsbury Academic. 2017. 220 pages. Price US $ 124.95 (Hardback).

China is still considered to be a polluter and its city life is deplorable with unbreathable air and contaminated drinking water. These are the thoughts of the past and China is now bidding to emerge as an environmental soft-power at an impressive rate. The main argument of this book revolves around China's rapid urbanisation and China's government-led eco-city building programme. It is an attempt to falsify the Manichean Worldview of China, which tries to provide comprehendible classifications of a country that is much advanced for that. With rapid development and wealth creation, China's fast urbanisation has outpaced that of any other country in the world, adding 458 cities in just last 4 decades—110 cities in a decade. But China is now pausing to think what it had done right and wrong in the last 40 years. William starts the book by explaining what a city is as well as the eco-city, and simplifies the definition of eco-city provided by the Chinese government i.e. a city where main drinking water sources are 'adequate' and its air quality is rated 'good' on 123 days of a year. Then he moves on how China has turned barren lands into wealth creating giants. But all this wealth and prosperity at that pace resulted in urban challenges like degraded environment. Over the course of the book, William contextualises the Chinese society and its evolution with respect to political events. Wealth creation is still the top priority of the Chinese government. To portray a soft image of the country, China is trying on multiple facets. For example, the Chinese Society for Urban Studies has created a new 28-item eco-city friendly list, which is different from other checklists such as by UNHABITAT and BREEAM. Throughout the book William uses sarcastic notes on how China is learning to experiment with spaces either by inviting rural households to newly developed cities or by reforming the older ones. From the book, it looks like there is a long way ahead for China to become eco-friendly. [*Aqeel Anwar Chaudhry*]