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Shahid*

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Karachi Stock Exchange**

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Size and Value Premium in Karachi Stock Exchange

Nawazish Mirza^{*} and Saima Shahid^{}**

Abstract

This study evaluates the ability of the Fama and French Three Factor model to explain a cross section of stock returns in the Karachi Stock Exchange (KSE). Following Fama and French factor approach, we sorted six portfolios by size and book to market. The sorted portfolios were constituted to represent stocks from each and every sector of KSE. Using Daily returns from January 2003 to December 2007, the excess returns for each portfolio were regressed on market, size and value factors. Our findings, in general, supported the notion of the three factor model. The three factor model was able to explain the variations in returns for most of the portfolios and the results remain robust when the sample was reduced to control for the size effect. Our findings are consistent with most of the studies that suggested the validity of the three factor model in emerging markets. These results warrant for the inclusion of size and value factors for valuation, capital budgeting and project appraisals, thus, having substantial implications for fund managers, analysts and investors.

JEL Classification: G11, G12, G14.

Keywords: Size Premium, Value Premium, Market Premium, Three-Factor Model.

I. Introduction

The Fama and French (FF) three-factor model has emerged as an alternative explanation for the ongoing debate on asset pricing. FF start with the observation that two classes of stocks have performed better than the market as a whole. These include stocks with small market capitalization and stocks with high book-to-price ratios (market value). The book-to-market ratio compares the book value of a stock's equity with that of its market value. High book-to-market ratio stocks are termed value

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stocks while low book-to-market stocks are called growth stocks. Since these stocks yielded a higher return than the market, FF observed that such a phenomenon was explained by the existence of *size* as well as *value* premium in addition to the market risk premium as posited by the traditional Capital Asset Pricing Model (CAPM).

To account for these two premia, FF constructed two more risk factors outside of market risk. They used *SMB* (small minus big) to address size risk and *HML* (high minus low) for value risk. The size factor measures the additional returns investors receive for participating in stocks with comparatively small capitalization. The positive *SMB* factor represents more returns for small cap stocks vis-à-vis big stocks and vice versa. The value factor captures what premium investors will get while investing in stocks with a high book-to-market ratio. A positive *HML* signifies more returns for value stocks than growth stocks.

The three-factor model can be expressed as follows:

$$E[R_{it}] - R_{ft} = \beta_{i,1} (E[R_{mt}] - R_{ft}) + \beta_{i,2} [SMB_t] + \beta_{i,3} [HML_t] \quad 1$$

Where $E[R_{it}]$ represents expected return on stock i , $E[R_{mt}] - R_{ft}$ represents market premium, SMB_t is the size premium, and HML_t represents value premium. The coefficients represent the risk sensitivities for market risk ($\beta_{i,1}$) followed by size ($\beta_{i,2}$) and value ($\beta_{i,3}$). The market risk coefficient is akin to Sharpe's CAPM but different in the sense that the three-factor model's explanatory function will be shared by two other risk factors.

Markets outside North America and Western Europe have grown rapidly in the last two decades. A significant change in financial markets is the evolution of emerging markets where the potential for investment in terms of risk and return is reasonably high. The International Finance Corporation (IFC) rates approximately 30 countries as emerging markets, which are characterized by distinct market dynamics and investment behavior. These economies have smaller financial markets in proportion to their economies size vis-à-vis developed markets. Other important aspects of emerging markets are the level of activity and their openness to foreign investors. In the presence of thin trading, informational inefficiency, panics, bubbles, and lack of transparency, overall investor activity remains range-bound to certain stocks (Li and Richard 2004). These differentiating factors warrant an examination of the behavior of asset pricing in emerging

markets. With monetary integration and globalization, investors tend to diversify their portfolios by participating in developed as well as emerging international markets. Therefore, it is vital to analyze the applicability of asset pricing models in an emerging scenario to support investment decisions.

Pakistan has been classified as an emerging market. Unfortunately, the Pakistani literature on asset pricing is very rare in general and almost nonexistent as far as size and value premium are concerned. There are three stock exchanges¹ in Pakistan with the Karachi Stock Exchange (KSE) being the most liquid and the biggest in terms of market capitalization and trading volume and been awarded the title of “best performing emerging stock market of the world” in 2002 by Business Week.

The FF three-factor model has emerged as an alternative explanation for the ongoing debate on asset pricing². The discrepancies in CAPM have contributed to the success of alternative explanations. Fama and French (1998) advocate a global version of their model. They studied 13 world markets during 1975–1995 and showed that value stocks tend to yield higher returns than growth stocks. They also sorted the portfolios on book-to-market ratio and found that, in 12 of 13 countries, value stocks outperformed growth stocks. Similar results were observed for emerging markets. They noted that an international CAPM did not explain value premiums in international markets.

Although the FF model is quite simple, there is considerable empirical controversy over the interpretation of its risk factors. Some researchers have proposed that the existence of the book-to-market premium is not due to investors’ compensation for risk bearing as much as investors’ overreactions (Lakonishok, Shleifer, and Vishny 1994, Haugen (1995)]. They suggest that investors overreact to corporate news and exaggerate their estimates about future growth. Consequently, value stocks tend to be under-priced while growth stocks tend to be over-priced. Another group of critics relates the success of the FF model to empirical

¹ These include Karachi Stock Exchange (KSE), Lahore Stock Exchange (LSE) and Islamabad Stock Exchange (ISE).

² The significant literature on asset pricing models and their subsequent extensions include propositions by Tobin’s (1958) separation theorem, Sharpe (1964), Linter (1965), Mossin (1966) capital asset pricing model (CAPM), Black’s (1972) Zero Beta CAPM, Merton’s (1973) Intertemporal CAPM, Breeden’s (1979) consumption based CAPM and Ross’s (1976) Arbitrage Pricing Theory.

gimmicks (Ferson, Sarkissian, and Simin 1999). They suggest that the explanatory power of the three-factor model is due to econometric irregularities. This could be due to inherent biases or data mining that exaggerates results for the three-factor model. Berk (1995) suggests that the way in which portfolios for high book-to-market and size ratios are constructed implies that they are expected to yield high returns, regardless of any economic interpretation.

The aim of this article is to study the power of the FF three-factor model to explain returns on KSE traded stocks. The outcome of this research could provide an insight into the model's capacity to explain the puzzling risk-return relationship in an emerging market.

The rest of the paper is organized as follows. Section II summarizes some of the existing literature on size and value premiums. Section III discusses the data and methodology used. Empirical results are presented in Section IV, and Section V concludes the article.

II. Literature Review

Fama and French (1992) examine a cross section of stock returns and present the additional factors of size and value premium to clarify the return anomalies that CAPM was unable to explain. They use nonfinancial firms' data from NYSE, AMEX, and NASDAQ for the period 1962–1989. Stocks are sorted by size (measured by the market value of equity) for all three markets, and ten size-based portfolios constructed. The model is tested using the Fama–MacBeth regression approach. The results support the notion that size helps explain the cross section of returns; while beta alone is not sufficient to explain the variations. Similar results are obtained for the book-to-market (value premium) ratio. Fama and French note that, although the book-to-market ratio has a stronger impact than size, it cannot replace the latter in explaining average returns; when both are combined in the model, it yields even better results.

They conclude (i) that, if asset pricing is rational, the additional risk factors of size and book-to-market ratio seem to describe average returns, and (ii) that the probability that such results were due to chance is remote. They add that economic fundamentals suggest that high book-to-market ratio firms are likely to remain less profitable vis-à-vis low book-to-market firms. Moreover, during the sample period, small firms generated fewer earnings than bigger firms. Thus, it is likely that these

variables are considered by investors while pricing an asset. On a concluding note, Fama and French argue that according to a rational pricing decision, investors are likely to factor in size and value premium. They do, however, admit that if stock prices emerge from irrational investment behavior, there is a smaller chance that their results will persist.

Fama and French (1993) extend their 1992 research by applying a time series regression approach. The analysis was extended to both stocks and bonds. The monthly average returns on stocks and bonds were regressed on five other factors: (i) excess returns on market portfolio, (ii) portfolios sorted by size, (iii) portfolios sorted by book-to-market ratio, (iv) term premium, and (v) default premium. They found that the first three factors were significant for stocks while the last two were significant in explaining returns on bonds. They confirmed the existence of size and value premia in US returns and commented that a three-factor model provided a better explanation for the risk return puzzle.

Fama and French (1995) try to provide an economic rationale for their three-factor model by relating risk factors to earning shocks. They study the characteristics of value as well as growth firms. Their analysis is that firms with a high book-to-market ratio tend to be in consistent distress, while firms with a low book-to-market ratio show sustained profitability. This leads to the conclusion that returns on high book-to-market stocks compensate for holding less profitable and riskier stocks. The results demonstrate that the sensitivities of HML and SMB are a proxy for relative distress. Firms with low earnings had a high book-to-market ratio and a positive slope for HML, while firms with high earnings had a low book-to-market ratio and a negative HML slope.

Claessens et al (1995) examine a cross section of asset returns in emerging markets. They use data from the International Finance Corporation (IFC) for 18 developing countries for the period 1986–1993, and analyzed the impact of risk factors, besides betas, and their impact on asset returns. They conclude that, in addition to beta, two factors, i.e., size and trading volume have the highest explanatory power in most countries. Dividend yield and earning-to-price ratio were also significant but in fewer countries. Lastly, they propose that exchange rate risk is an important determinant of asset returns.

Daniel and Titman (1997) use a factor analysis approach to study the impact of loadings on stock returns from 1973–1993. They investigate

the rationale behind different returns on portfolios that have similar characteristics with varying factor loadings. After controlling for the size and book-to-market ratio, they find that expected returns are not a function of loadings on the Fama and French risk factors. They posit that it is the covariance between high book-to-market ratio stocks that leads to similar properties rather than a common risk factor.

Halliwel et al (1999) replicate the Fama and French (1993) study using Australian data. Their results suggest some premia on small sized and high book-to-market ratio stocks. Despite observing some premia on the SMB and HML factors, there are some inconsistencies with respect to the FF three-factor model. First, the explanatory power of the three-factor model is not as strong as was observed in the case of US markets. Second, Fama and French (1993) report that there is a tendency for size sensitivity to fall when moving from lower to higher book-to-market portfolios. However, Halliwel et al (1999) do not find any evidence for the decrease in size sensitivity, given a transition from low to high book-to-market ratio stocks. Third, Fama and French (1993) report a significant improvement in the adjusted R^2 when they move from a single factor to three factors, while Halliwel et al (1999) observe only a marginal improvement in R^2 .

Davis et al (2000) make an extensive study of the characteristics, covariances and average returns of a sample from 1929 to 1997. They decompose the sample into two periods. The first observation period is from July 1929 to June 1963, and the second from July 1963 to June 1997. The value premium, measured by the HML factor for the first half was 0.5% per month and was statistically significant ($t = 2.80$). This is similar to the value premium observed by other authors for the second period, valuing 0.43% per month with a higher significance level ($t = 3.38$). However, the observed size premium was lower than the value premium. Represented by the SMB factor, the size premium was 0.20% for the whole sample period. They conclude that the value premium in average stock returns is robust. Their sample period is longer than that of Daniel and Titman (1997), and their results contradict those of the latter: Davis et al (1997) find a relationship between returns and factor loading, and suggest that Daniel and Titman (1997) results were subject to a low power of tests and a comparatively shorter time span.

Aleati et al (2000) investigate the relationship between risk factors and returns for Italian stocks. They use factor analyses and time series regressions to identify the economic variables in Italian stock markets.

They use the stocks listed on the Italian Stock Exchange from 1981–1993. Unlike most researchers, they use individual stock returns rather than portfolio returns due to the small number of listed firms in Italy. Aleati et al find out that changes in market index, oil prices, default premium, interest rates, and SMB and HML are viable factors for determining asset returns in Italy. The SMB and HML factors are priced in the market even when other macroeconomic variables are added.

Connor and Sehgal (2001) compare the three-factor model with CAPM to determine which model better explains the cross section of portfolio returns in the Indian stock market. The sample companies for their study were drawn from CRISIL 500 (similar to the S&P index in the US). The companies were sorted by book-to-market ratio, taking above-median stocks as *high* and below-median stocks as *low*. Market capitalization was similarly sorted with the upper 30% as *big*, the middle 40% as *medium*, and the lower 30% as *small*. Further, six portfolios were formed on the intersection of size and book-to-market sorting. Connor and Sehgal (2001) analyze the comparative level of intercepts by applying the adjusted Wald Statistic. In CAPM, three out of six portfolios showed a significant intercept, while in the FF three-factor model, intercepts for all six portfolios were insignificant. Based on the evidence provided by the intercepts of time series regression for both models, the authors conclude that the FF three-factor model is a better fit for the Indian stock market.

Drew and Veeraraghavan (2002) study the existence of size and value premiums in emerging markets. Using data for the Malaysian market from December 1991 to December 1999, they form six portfolios at the intersection of two size and three book-to-market portfolios. Their findings imply the existence of size and value premiums that are not documented by the CAPM. They observe that the SMB and HML portfolios generate average returns of 17.7% and 17.6%, with a standard deviation of 5.3% and 6.1%, respectively; while the market or index returns for the period was substantially lower at 1.92%, demonstrating a much higher risk premium for the size and value factors. They reject the possibility that these results could be due to a survivorship bias or data mining. Further, they reject the possibility of seasonality in returns and comment that the explanatory variables are strong enough throughout the period to reject the presence of the turn-of-the-year effect. Thus, the evidence supports the notions of value and size premium in international markets.

Beltratti and Di Tria (2002) assess the relevance of multifactor asset pricing models for Italian stocks from 1991 to 2000. The purpose of their research is to analyze the extent to which financial variables can be used as proxies for macroeconomic risk and their relation with the business risk. They compare four asset pricing models, including the simple CAPM, the FF three-factor model, a multifactor model including sectors, and a multifactor model including changes in short-term interest rates. Furthermore, they also study the impact of sample design on the construction of HML and SMB factors.

The results demonstrate that the FF three-factor model, among others, best explains the cross section of returns in Italian markets. The explanatory power of the model is dependent on the approach of the tests. The time series estimates resulted in constants that were significant, while in cross section regressions, none of the coefficients was significant although theory suggests that average risk premiums should be significantly positive. They attribute these discrepancies to the instability in Italian markets that has generated unexpected returns for the investors; and commented that the time series approach is best used for the Italian market; time series analysis reveals the FF three-factor model to be most appropriate. However, they point out that the result could not establish a robust relationship between SMB, HML, and certain important macroeconomic variables. They propose the existence of other *local* factors that might better explain the variability in returns. Lastly, they raise the issue of strong non-normality in returns for the factor portfolios.

Drew and Veeraraghavan (2003) compare the explanatory power of a single-index model with that of the FF three-factor model. The countries examined are Hong Kong, Korea, Malaysia, and Philippines. They conclude that there were size and value premiums in these markets and that the three-factor model better explained the variations in return for these markets. They comment that the premiums are compensation for risk that is not accounted for by CAPM.

III. Research Methodology

As mentioned earlier, the dynamics of emerging markets are different from developed ones. KSE was declared an open market in 1991 although the pace of market activity remained stagnant till 2002. Starting from 2003, Pakistani markets have seen a new bull rally that continued until March 2008 with some corrections and a few panics. In general, however, investor sentiment is positive and it is believed that the market

hype is backed by strong fundamentals. The pre-2003 era was dominated by low activity, fewer investors, and high transaction costs.

The sample 5-year period thus chosen for this study was from 1 January 2003 to 31 December 2007. Another reason that validates this time period selection is the events of 11 September 2001. The post-9/11 world has presented a completely different investment scenario. Attributes and investment behavior are more cautious and risk averse. Had the sample period included both pre- and post-9/11 data, the difference in investment characteristics could have created a potential bias in results, which is why it seemed prudent to include a 1-year lag and start with data for January 2003.

III.I. Model Specification

Fama and French contend for a multifactor asset-pricing model: their three-factor model is an extension of a single-factor CAPM. Besides the traditional beta, it includes two additional factors to account for size and value premiums. Mathematically, we can represent the three-factor model as

$$E[R_{it}] = R_{ft} + (E[R_{mt}] - R_{ft})\beta_{i,1} + (SMB_t)\beta_{i,2} + (HML_t)\beta_{i,3} \quad 2$$

with $t = 1, 2, 3, \dots, T$

Where $E[R_{it}]$ represents expected return on stock i , $E[R_{mt}] - R_{ft}$ represents market premium, SMB_t is the size premium and HML_t represents the value premium. The coefficients are the risk sensitivities of returns for market risk ($\beta_{i,1}$) followed by size ($\beta_{i,2}$) and value ($\beta_{i,3}$).

To test the FF three-factor model, we follow the traditional multivariate regression framework and transform the above equation into a simple time series model represented as follows:

$$ER_{it} = \alpha_i + RP_t\beta_{i,1} + (SMB_t)\beta_{i,2} + (HML_t)\beta_{i,3} + e_{it} \quad 3$$

Where $ER_{it} = E[R_{it}] - R_{ft}$ is the excess return on stock i , $RP_t = E[R_{mt}] - R_{ft}$ is the risk premium, α_i is the intercept of the regression equation representing a nonmarket return component, while e_{it}

represents a random return component due to unexpected events related to a particular stock. We assume that e_t has a multivariate normal distribution and is independently and identically distributed over time. If the model holds, α_i will prove nonsignificant.

The above model represents the three-factor model for an individual stock. By replacing security i with a portfolio of stocks P, the three-factor model can be expressed as follows:

$$ER_{P_t} = \alpha_P + RP_t\beta_{i,1} + (SMB_t)\beta_{i,2} + (HML)\beta_{i,3} + e_{it} \quad 4$$

Where $ER_{P_t} = R_{P_t} - R_f$ and $R_{P_t} = \sum_{i=1}^N w_i R_{it}$ with w representing the weight of stock in portfolio.

Thus, the excess portfolio return can be reflected as $ER_{P_t} = \sum_{i=1}^N w_i R_{it} - R_f$, and the nonmarket return component will be $\alpha_P = \sum_{i=1}^N w_i \alpha_i$ which is the average of the individual alphas.

III.II. Dependent and Independent Variables

III.II.I. Dependent Variable

The dependent variable for the FF three-factor model is the excess portfolio return, represented by ER_{P_t} . The excess return reflects the return over and above the risk-free rate required by the investor to justify risk taking. As already mentioned, the portfolio return is the weighted average of all stocks included in a portfolio.

III.II.II. Independent Variables

Independent variables include *market risk premium*, *size factor*, and *value factor*. Market risk premium, measured as the difference between the return on a market portfolio and risk-free rate, represents the excess return that an investor could earn if they invested in a market portfolio rather than a risk-free asset. The market risk *premiums* and excess return is the same in both the CAPM and three-factor model. However, the latter has two other variables. *SMB* or size premium captures the additional return offered by

small firms vis-à-vis big firms. Similarly, the *HML* or value premium captures the additional return offered by firms whose BV to MV ratio is lower.

The theoretical foundations of the *SMB* and *HML* factors are intuitively appealing. Small companies are more sensitive to various risk factors because they are less diversified and have less financial flexibility than larger firms. Therefore, investors should require a risk premium while investing in small capitalization firms. The *HML* factor places a higher risk on value stocks than growth stocks. A high book-to-market ratio depicts a deviation in the book value of the firm from its market value, indicating that the market is not placing high value on stocks. This could be due to current distress or investors' expectations about future prospects, making such companies vulnerable to business risk as well as financial risk and, in turn, making it logical for investors to demand a premium on such stocks.

III.III. Sample Selection and Criteria Limitations

As discussed earlier, this study tests the performance of the FF three-factor model when applied to the KSE for 5 years from 1 January 2003 to 31 December 2007. The sample consists of companies from all industrial and nonindustrial sectors listed on the KSE. Following is a list of criteria that was employed to select stocks from these individual sectors.

1. All selected stocks must be public limited companies listed on the KSE.
2. For selected companies, daily price data, book value and market value of equity, and market capitalization should be available.
3. The selected stocks must have survived the 5-year period.
4. In order to avoid thinly traded stocks, only those stocks were included that had been traded for at least 90% of trading days during the sample period.
5. Fama and French do not include financial sector firms in their study. However, due to active participation of banking stocks in the KSE, we have not excluded the financial sector.
6. Once the sample was selected, it was sorted on the basis of market capitalization and compared across sectors. To eliminate extremely small firms and create some homogeneity with respect to size, the

lower 5% was excluded. Based on this criterion, 81 companies were selected. Following the FF methodology, the portfolios were reformed in December of each year based on the book value of equity.

Table-1 summarizes the participation of each industrial sector in the selected sample.

Table-1: Number of Selected Companies for Each Sector

No	Sector	No. of Companies	% in Sample
1	Auto Assembler	4	4.94%
2	Automobile Parts	1	1.23%
3	Banks	10	12.35%
4	Cable and Electrical Goods	1	1.23%
5	Cement	5	6.17%
6	Chemicals	2	2.47%
7	Engineering	2	2.47%
8	Fertilizers	3	3.70%
9	Food and Personal Care	5	6.17%
10	Glass and Ceramics	4	4.94%
11	Insurance	5	6.17%
12	Jute	1	1.23%
13	Leasing	3	3.70%
14	Leather	2	2.47%
15	Oil and Gas Exploration	2	2.47%
16	Oil and Gas Marketing	4	4.94%
17	Paper and Board	2	2.47%
18	Pharmaceutical	3	3.70%
19	Power	5	6.17%
20	Refinery	2	2.47%
21	Sugar	3	3.70%
22	Technology	2	2.47%
23	Textiles	5	6.17%
24	Tobacco	2	2.47%
25	Transport	2	2.47%
26	Vanaspati	1	1.23%
	Total	81	

The financial sector, including banks, insurance, and leasing stocks constitutes approximately 23% of the total selected sample. The higher proportion of financial firms in the sample is attributed to the activity of

these stocks on the KSE with stocks like MCB, NBP, and Orix Leasing etc. leading in volume. As mentioned earlier, most studies have excluded the banking sector due to highly differentiated risk profiles. Another reason for excluding them is that, in most developed markets, banking stocks are subject to thin trading and are not dominant vis-à-vis other sectors. However, the dynamics in emerging markets in general and Pakistan in specific are such that the exclusion of the banking and financial sector is not justified. The dominance of the banking sector was deemed helpful in analyzing the robustness of the three-factor model.

The textiles sector has a moderate contribution of 6%. Despite being the largest sector, the low participation of the textiles sector in our sample is due to the fact that most textile stocks are subject to thin trading, with some stocks reporting zero trade for the sample period. Other dominant sectors in the sample are automobile assemblers and power, some of which have highly liquid stocks.

III.IV. Types and Sources of Data

We use secondary data from the KSE for this study. As reported by Davis (1994), the frequency of returns estimate does not improve or deteriorate results. Daily returns were used to increase the number of observations. To estimate daily returns, we use daily closing stock prices. The observation of the true market portfolio within the framework of various asset-pricing models is not possible and for empirical studies *synthetic market portfolios* are used. Our aim was to mimic the market portfolio by using the KSE 100 index.

A risk-free asset is one that yields a certain return. In practice, no such assets exist and investors use government-issued securities as risk-free assets and their returns as risk-free rates. However, even if these securities are default risk-free, they are not entirely risk-free and, at the least, carry inflation risk. For this analysis, we use the six months' Pakistan treasury bill yield as a risk-free proxy.

III.IV. Estimation of Variables

III.IV.I. Daily Portfolio and Market Returns

Portfolio returns are the weighted average returns on individual stocks. These returns are estimated as follows³:

$$R_{p_t} = \sum_{i=1}^N w_i R_{it}, \text{ and } R_{it} = LN \left[\frac{P_t}{P_{t-1}} \right],$$

where P_t and P_{t-1} are closing prices on day t and $t-1$. These individual returns are then weighted according to their contribution to the portfolio to obtain portfolio returns.

Similarly, the return on market portfolio is represented by return on KSE-100 index $R_{m_t} = LN \left[\frac{KSE(100)_t}{KSE(100)_{t-1}} \right]$, with $KSE(100)_t$ and $KSE(100)_{t-1}$ as the closing index values on day t and $t-1$. The portfolio and market returns are then used to estimate excess portfolio returns ($R_p - R_f$) and market risk premium ($R_m - R_f$).

III.IV.II. Size and Book-to-Market Portfolios

The selected sample stocks were ranked by degree of market capitalization (price times number of shares) to denominate size from 2003 to 2007, taking 31st December of each year as the reference point. The median of the sample was used to split the stocks into two categories, namely *big* (B) and *small* (S). Table-2 represents the biggest, median, and smallest capitalization stocks in the sample.

Table-2: Size Sorted Portfolios (2003–2007)

No	Size	Capitalization (Million of PKR)
1	Maximum(B)	180,308
2	Median	4,682
3	Minimum (S)	31

The book-to-market (BM) ratio is calculated by dividing the book value of equity by market value of equity on 31st December for each year of the sample. Stocks are then ranked and categorized into three BM

³ The prices are adjusted for dividends and therefore returns incorporates dividend factor.

groups based on the break points of the bottom 30% classified as low (L), the middle 40% classified as medium (M), and the top 30% classified as high (H). Six portfolios are formed on the intersection of two size and three book-to-market portfolios. These six portfolios are B/L, B/M, B/H, S/L, S/M and S/H. The B/L portfolio contains stocks that are in the big group and have a low BM ratio; the S/H portfolio contains stocks that are in the small group and have a high book-to-market ratio.

Fama and French (1996) and Lakonishok, Shliefer, and Vishny (1994) contend for equally weighted portfolios and suggest that the three-factor model performs even better in equally weighted portfolios than in value-weighted portfolios. Therefore, for this study, we build equally weighted portfolios to compute portfolio returns. Table 3 represents sector wide-participation in these six portfolios.

Table-3: Sector-Wise Size and Book-to-Market Portfolios

No	Sector	S/H	S/M	S/L	B/H	B/M	B/L	Total
1	Auto Assembler	1	0	1	0	0	2	4
2	Automobile Parts	0	1	0	0	0	0	1
3	Banks	1	0	0	1	6	2	10
4	Cable and Electrical Goods	0	1	0	0	0	0	1
5	Cement	1	0	0	2	2	0	5
6	Chemicals	0	0	0	1	0	1	2
7	Engineering	0	1	0	0	0	1	2
8	Fertilizers	0	0	0	0	0	3	3
9	Food and Personal Care	2	1	1	0	0	1	5
10	Glass and Ceramics	2	2	0	0	0	0	4
11	Insurance	0	3	0	0	0	2	5
12	Jute	0	0	1	0	0	0	1
13	Leasing	1	2	0	0	0	0	3
14	Leather	0	1	1	0	0	0	2
15	Oil and Gas Exploration	0	0	1	0	0	1	2
16	Oil and Gas Marketing	0	0	0	0	2	2	4
17	Paper and Board	0	1	0	0	0	1	2
18	Pharmaceutical	0	2	0	0	0	1	3

19 Power	3	0	0	1	1	0	5
20 Refinery	0	0	0	0	0	2	2
21 Sugar	2	1	0	0	0	0	3
22 Technology	1	0	0	0	1	0	2
23 Textile	2	2	0	0	1	0	5
24 Tobacco	0	0	0	0	1	1	2
25 Transport	0	0	0	1	1	0	2
26 Vanaspati	1	0	0	0	0	0	1
Total	17	18	5	6	15	20	81

III.IV.II. Market Premium SMB and HML Factors

The market premium was estimated as the difference between returns on the KSE100 index and the 6-month T bill yield. As mentioned before, this factor is similar to CAPM, but incorporates two more risk factors, namely SMB and HML. The market risk premium was estimated as follows:

$$RP_t = R_{mt} - R_f$$

SMB capture the risk premium attached to returns related to firm size. It is the difference between the average returns on the three equally weighted small market capitalization portfolios and the three big market capitalization portfolios. Mathematically, we have:

$$SMB = \frac{[S/L + S/M + S/H]}{3} - \frac{[B/L + B/M + B/H]}{3} \quad 5$$

HML accounts for the risk premium that is related to firm value. It is the difference between the returns on the portfolio of high book-to-market ratio stocks and returns on the portfolio of low book-to-market ratio stocks, constructed to be neutral vis-à-vis size. It can be represented as follows:

$$HML = \frac{[S/H + B/H]}{2} - \frac{[S/L + B/L]}{2} \quad 6$$

Given that the data frequency is daily; all our estimates are on an intra-day basis.

III. V. Hypotheses

The regression model was applied to test the validity of the FF three-factor model. It was tested for the six size and book-to-market portfolios. The excess returns on each portfolio were regressed on three factors, namely market risk premium, size premium, and value premium. The model is expressed below:

$$ER_{it} = \alpha_i + RP_t \beta_{1t} + (SMB) \beta_{2t} + (HML) \beta_{3t} + e_t$$

Since this is a multivariate regression model, the following hypotheses will be tested.

$$H_1 : \alpha_p = 0$$

$$H_2 : \beta_{i,1} = 0$$

$$H_3 : \beta_{i,2} = 0$$

$$H_4 : \beta_{i,3} = 0$$

Where α_p represents the regression intercept and $\beta_{i,1}$, $\beta_{i,2}$ and $\beta_{i,3}$ represent risk sensitivities of portfolio returns. The three-factor model will hold if the intercept is not significant (statistically 0) and the three slope coefficients are significant (statistically different from 0).

IV. Empirical Results and Analysis

IV.I. Descriptive Statistics

Daily returns between January 2003 and December 2007 were computed for six sorted portfolios. Table-4 shows descriptive statistics for each portfolio:

Table-4: Descriptive Statistics of Daily Returns (2003-2007)

	S/M	S/L	S/H	B/M	B/L	B/H
Mean	0.07%	0.001%	0.01%	-0.03%	0.04%	-0.06%
Median	0.15%	0.06%	-	-0.04%	0.12%	-0.10%

			0.07%			
Maximum	4.93%	8.77%	4.80%	10.08%	4.48%	5.30%
Minimum	-6.06%	-	-	-7.02%	-5.42%	-5.57%
Std. Dev.	1.20%	2.04%	1.24%	1.55%	1.21%	1.43%

For the sample period, the S/M portfolio offered the highest average daily return of 0.07%, followed by B/L (0.04%). The maximum per day return was yielded by big stocks with an average book-to-market ratio (10.08%), and the minimum daily return for the observation period was yielded by small stocks with a low book-to-market ratio.

Daily standard deviations were on the higher side with 2.04% for S/L stocks as a maximum and 1.20% for the S/M portfolio as a minimum. The higher standard deviations for all these portfolios demonstrate a high-risk profile for the sample stocks in specific and the Pakistani market in general.

Table-5 documents similar characteristics for KSE 100 index returns.

Table-5: Descriptive Statistics of KSE 100 Daily Returns (2003-2007)

	Mean	Median	Maximum	Minimum	Std. Dev.
KSE100	0.133%	0.244%	5.797%	-6.042%	1.515%

The mean average daily returns on the index portfolio are 0.133% with a maximum of 5.7% and a minimum of -6.04% with a standard deviation of 1.51%.

From 2003 to 2007, the average daily market risk premium was dominant as compared to size and value premiums. Interestingly, the magnitude of the average value premium was negative, due to negative mean returns on the S/H and B/H portfolios. Given negative mean returns for the HML factor, we can conclude that, on average, growth stocks outperform value stocks in terms of returns. However, the size premium was positive, with small stocks generating higher average returns and thus outperforming large caps. Table-6 summarizes the results for the three factors.

Table-6: Factor Statistics (2003–2007)

	RP	SMB	HML
Mean	0.114%	0.012%	-0.065%
Median	0.224%	0.002%	-0.122%
Maximum	5.782%	3.075%	4.906%
Minimum	-6.065%	-3.919%	-4.540%
Std. Dev.	1.516%	0.862%	1.336%

Table-7 shows the correlation between the returns on portfolios. The maximum correlation is 32% between small stocks with a medium and low book-to-market ratio. The B/H and S/M portfolios also depict a similar level of correlation of returns.

Table-7: Correlations between Sorted Portfolio Returns

	S/M	S/L	S/H	B/M	B/L
S/L	32.22%				
S/H	8.42%	13.19%			
B/M	24.21%	-37.24%	17.70%		
B/L	-29.73%	-12.24%	-74.16%	-9.23%	
B/H	32.07%	16.57%	29.72%	-4.54%	-31.38%

IV.II. Regression Results

Our analysis was based on a multivariate regression. The dependent variables were the excess returns on six size and book-to-market portfolios; independent variables were the three risk premiums (RP), size premium (SMB), and value premium (HML). Table-8 provides the correlation matrix of independent variables, i.e., three risk premiums.

Table-8: Correlations between Independent Variables (2003 – 2007)

	RP	HML
HML	0.76%	
SMB	-5.58%	-49.64%

The observed correlations between the three independent variables were negligible between market premium and value premium (0.76%); and between market risk premium and size premium (-5.5%). On the contrary, the coefficient was high for size risk premium and value risk premium, although in the opposite direction.

With a low correlation between market risk premium and size risk premium and value risk premium, it is clear that SMB provides a valid

rationale for a size premium that is relatively free of market risk premium. Similarly, HML can be regarded as a measure of value premium that is not dependent on market risk premium.

Table-9 summarizes the results of the FF three-factor model. The test of the three factors assumes that the intercept should not be significantly different from 0 and that the slope coefficient should be significant. The study yields mixed results for the validity of the three-factor model. The estimated coefficients are encouraging for the existence of size and value premiums in the KSE, but they negate the presence of a market risk premium. In six size-to-value portfolios, the results were significant for four portfolios (B/H, B/M, B/L, S/H) while for the S/M and S/L portfolios null hypotheses could not be rejected for the intercept.

Table-9: Three-Factor Regression on Portfolios Sorted for Size and Book-to-Market Ratio⁴

	1	2	3	t()	T(1)	t(2)	t(3)	R ²	
B/H	-0.0001	-0.012	-0.013	0.692	-0.475	-0.593	-0.312	25.821*	0.424
B/M	0.0001	-0.003	-1.057	0.352	0.205	-0.158	-28.806*	14.869*	0.617
B/L	-0.0001	-0.015	-1.070	-0.957	-0.792	-1.972*	-69.324*	-96.197*	0.890
S/H	0.0003	0.024	0.371	0.674	0.929	1.321	10.117*	28.573*	0.408
S/M	0.0009	0.046	0.137	0.444	2.928*	2.258*	3.352*	16.865*	0.210
S/L	0.0010	-0.921	0.334	0.006	2.465*	-33.661*	6.019*	0.167	0.498

The existence of a market risk premium along with size and value premiums was supported in the B/L portfolio for which $R^2 = 0.89$. The value premium is significant for all portfolios and dominates the other two factors, although there is no size effect in the B/H portfolio. The signs of coefficients for the four portfolios were consistent with the FF proposition. The SMB coefficient was positive for the small portfolio (S/H) and negative for big firms (B/M⁵ and B/L), confirming the size premium. Similarly, the HML factor was negative for low BM stocks (B/L) and positive for high value stocks (B/H and S/H), demonstrating the existence of a value premium.

The overall performance of the model was adequate with a high R^2 . Furthermore, to substantiate the presence of the size effect among big and small firms, 1/5 of the sample firms around the median (17 in total) were eliminated. The remaining firms were sorted by size and book-to-market ratio, and the resulting factors were regressed on excess returns. The regression results for the reduced sample are reported in Table 10. These results confirm the existence of size and value premiums in the KSE for B/H, B/M, B/L and S/H portfolios. Moreover, insignificant coefficients for the S/L portfolio in the full sample became significant in the reduced sample on controlling for the size effect.

Given these regression results, we can deduce that the bulk of results are in favor of the FF three-factor model – at least in the case of

⁴ * Significant at 5%.

⁵ The model was also tested by excluding the banking stocks for B/M portfolio as it was likely that higher proportion of banks in portfolio could have contributed towards significant results. In the absence of banking stocks the results remained robust with significant market risk premium with $t_1(0.001)$, $t_2(0.05)^*$, $t_3(-0.88)^*$, $t_4(0.36)^*$ and (R^2 of 0.43).

KSE. In emerging markets like Pakistan, investors are more concerned about trading volumes and firm size. Since panics are common in such markets, investment decisions are driven by the presence of big liquid stocks and a premium is expected for small stocks.

Table-10: Three-Factor Regression on Portfolios with Reduced Sample Sorted for Size and Book-to-Market Ratio

		1	2	3	t()	t(1)	t(2)	t(3)	R ²
B/H	0.0007	0.0836*	-0.6744*	0.8308*	1.4633	2.6832	-12.9119	23.5228	0.6062
B/M	0.0011	0.0911*	-0.5953*	0.0932*	0.9788	3.7042	-14.4442	3.3431	0.2872
B/L	0.0011	0.0675*	-0.5233*	0.0188*	0.7790	3.1645	-14.6280	3.5039	0.2468
S/H	0.0012	0.0892*	0.6090*	0.9329*	1.0802	3.5352	14.3986	32.6181	0.4829
S/M	0.0010*	0.0477*	0.1400*	0.2651*	3.3848	2.3989	4.1982	11.7544	0.1162
S/L	0.0007	0.1053*	0.4579*	-0.2552*	1.4520	3.1493	8.1720	-6.7351	0.2071

* Significant at 5%

In this study, portfolios supporting the existence of size and value premiums consisted of stocks that were considered the best pick for local investors based on market activity and firm. An important consideration is that the sample period was, overall, a bull rally in Pakistan, and therefore results only confirm the presence of size and value premiums in a bullish market.

Nevertheless, an alternative explanation is possible for portfolios with significant intercepts and this could lead to further research. Daniel and Titman (1997) construct a characteristics model that expects non-zero intercepts when stocks have value premium loadings that are not balanced with their book-to-market ratio. Therefore, it is likely that the value loadings for S/M and S/L portfolios are not in proportion vis-à-vis their size and book-to-market ratios.

V. Conclusion

Asset pricing or, alternatively, expected rates of return are puzzles that financial economists have been trying to solve for almost half a century. The single- and multi-factor asset pricing models have had mixed results in different parts of the world. Some researchers advocate the single-factor beta as the most viable risk factor determining returns; others

report that the beta term is no longer viable. This paper tries to explore the power of the FF three-factor model in an emerging market.

The stocks were selected from the KSE were sorted into six portfolios at the intersection of size and book-to-market ratio. The sample period constituted daily stock returns between 2003 and 2007, and the KSE100 index was used as the benchmark for market returns with 6-month T-bill rate as the risk-free proxy. A multivariate framework was deployed to test for the validity of the three-factor model. The results showed that, except for two portfolios (S/M and S/L), the intercept terms were insignificant, implying that the FF three-factor model seemed to explain returns for the KSE. However, the market risk premium factor was relevant in explaining returns in only one of the six portfolios.

The empirical evidence suggests that the FF three-factor model is valid for the KSE. This observation has important implications for fund managers, investors, and corporate managers. Traditionally, fund managers and investors have used a single-factor model for portfolio management and asset valuation. The presence of two additional risk factors warrants their inclusion for investment analysis. The use of size and value premiums in addition to the market risk premium will result in a different risk return structure as compared with the single-factor model. The inclusion of additional risk premiums might require portfolio rebalancing by fund managers. Similarly, investors are likely to be willing to invest in small firms and value stocks to target higher returns. Moreover, with additional factors in place, the estimation of cost of equity might vary, and could ultimately change the estimates for project appraisals, financing choices, and composition of capital structure.

However, caution should be exercised since this research was conducted in a bullish market and it is not clear whether size and value premiums exist in a bearish market – this area is proposed for further research. It is proposed that the same data set be used to test the model without sorting the portfolios and to check its robustness for subtime periods (Jan 2003–June 2005 and June 2005–Dec 2007). It is further proposed that various data frequencies (weekly, monthly, etc.) should be used to test the efficacy of the model.

Asset-pricing models are valuable for deducing the economic rationale for investment decisions but they are burdened with problems when used to analyze human behavior. Financial economists have encountered problems whenever they have tried to model investor

psychology and the results for a particular time period might not be representative of actual investment behavior in subsequent time periods. This is due to uncertain future economic environments that cause the deviation between theoretical models and practice - the same could be the case with this research.

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An Investigation of the Effectiveness of Financial Development in Pakistan

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Abstract

This study attempts to discern the relationship between economic and financial development in Pakistan for the period 1973 - 2006. Vector error-correction modeling is used to identify the causality between economic and financial development and the exogeneity of the variable(s) in the model. These error correction terms have been derived from Johansen's multivariate cointegrating procedure. Results indicate that, in the long run, economic development causes financial development. Furthermore, the real output variable is found to be exogenous. Thus, financial development is seen to be ineffective in terms of economic development determination in Pakistan.

JEL Classification: C59, O16.

Keywords: Economic Development, Financial Development, Causality.

I. Introduction

This study is concerned with the issue of financial development in Pakistan for the period 1973 – 2006. We examine on the one hand the long run and short run causality between financial and economic development and on the other hand establishes the exogeneity of financial development using the Vector Error-Correction model (VECM) for Pakistan. The exogeneity of financial development implies that the financial system is ineffective in terms of economic development for Pakistan. Vector Error Correction Terms (VECTs) have been derived from Johansen's multivariate co-integrating testing procedure.

The study is structured as follows: Section II reviews the literature. Section III estimates the relationship between financial and economic

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development. Section IV explains the results and compares with other studies. Finally, we summarize and conclude in Section IV.

II. Review of Literature

Arestis and Demetriades (1997) examined the relationship between financial and economic development for South Korea for the period 1979:1 – 1991:4. They used the log of the ratio of bank deposits to nominal GDP as a proxy of financial depth/development, the log of real GDP per capita as a proxy of economic development, ex-ante real deposit rate of interest, the log of capital stock per head and a summary measure of financial repression. The principal components method was used to construct this measure. They assumed that inflation expectations were static. They used Johansen's co-integration analysis with VAR length of two. Results showed two cointegrating vectors. The income vector showed economic development and the real interest rate had a positive effect on financial development. They also modified the model for USA and Germany. They used the log of real GDP per capita as a proxy of economic development, the ratio of stock market capitalization to GDP, an index of stock market volatility⁶, the log of the ratio of M2 to nominal GDP and the log of the ratio of domestic bank credit to nominal GDP as proxies of financial depth/development for Germany and USA, respectively. They used the lag length of 4. Results again showed two cointegrating vectors. In the case of Germany, vector-1 showed that economic development and financial development had a positive relationship and vector-2 indicated that financial development and the stock market development had a positive relationship. Thus financial and stock market development had a positive effect on economic development for Germany. In the case of USA, results also indicated two cointegrating vectors and similar conclusions.

Arestis, Demetriades, Fattouh and Mouratidis (2002) examined the relationship between financial development and economic growth for Greece, Thailand, Philippines, Korea, India and Egypt for the period 1955-1997. They used cointegration and the Error Correction Model (ECM) for causality and exogeneity purposes. They used the ratio of nominal liquidity⁷ to nominal GDP and real per capita GDP as proxies of financial

⁶ Sixteenth term moving standard deviation of the end-of-quarter change of stock market prices was used for volatility.

⁷ Currency held outside the banking system plus demand and interest bearing liabilities of the banks and non-bank financial intermediaries.

and economic development, respectively. Control dummies were used for the un-weighted average of deposit and lending rates. They also used the real interest rate (discount rate minus expected inflation using current GDP deflator) and the summary variable of reserve and liquidity requirements by using the principal component method (if both variables were available). They found a unique cointegrating vector except for India where two vectors were found. This vector was normalized with respect to economic development. Results showed that financial and economic development variables had positive significant signs in all cases and the real interest rate had negative signs except Korea where this coefficient was insignificant and Thailand where the data for this variable was not available. The deposit and lending rates variables were found to be insignificant in all cases except for the case of Philippines where it had a positive significant sign. The reserve and liquidity requirements variable was also found insignificant in all cases except for the cases of India and Egypt where it had significant negative and positive signs, respectively. In the ECM, economic development was found exogenous. Thus, overall, on the one hand the role of interest rate was limited and on the other hand economic growth caused financial development.

Calderon and Liu (2003) examined the causality between financial development and economic growth for 109 industrial and developing countries including Pakistan for the period 1960-1994. They used Geweke's (1982) decomposition method. The ratio of the difference in broad money (M2) (deflated by CPI) to real GDP and the difference in deflated credit (provided by financial intermediaries to the private sector) to real GDP were used as proxies of financial development. The real GDP per capita growth rate was used as a proxy of economic growth. They also included a basic set of control variables⁸ and regional dummies for Latin America, East Asia, and Africa. They considered a panel of seven non-overlapping 5-year periods of observation and three non-overlapping 10-year periods of observation over the sample period. These panels (5 and 10-year) were further divided into two sub samples: 87 developing and 22 industrial countries. Results showed that bi-directional causality existed between financial and economic development for both developing and industrial countries.

⁸Control variables: human capital – the percentage of secondary school attained over age 15 years in total population, government consumption as a percent of GDP and black market exchange rate premium.

Christopoulos and Tsionas (2004) investigated the causality between financial development and economic growth for 10 developing countries for the period 1970-2000. They used the ratio of total bank deposit liabilities to nominal GDP and real GDP as proxies of financial and economic development, respectively. They also used the ratio of fixed capital formation to nominal GDP and the inflation rate (which was measured by using CPI) in the model. They found one cointegrating vector, which was normalized with reference to output. This vector showed that financial depth had a positive significant sign for all countries, and the inflation rate was insignificant in all cases except Peru where it had negative significant sign. The fixed investment ratio had a positive significant sign in five countries. Results also indicated, in the panel data error correction model, that the error correction term was significant and thus there was evidence of causality from financial to economic development. However, in the country to country case, the error correction terms were insignificant so no causality between finance and output was found except for Dominican Republic.

Ghirmay (2004) empirically explored the causal links between the level of financial development and economic growth for 13 Sub-Saharan African countries for the period 1965-2000. He analyzed each country separately by employing cointegration and error correction models. He used the log of real GDP as a proxy of economic development. The log of credit to the private sector by financial intermediaries was used as a proxy of financial development. For lag determination he used a general to specific approach with at most 10 percent level of statistical significance. Results showed that financial development and economic development were cointegrated, and had a positive sign except Zambia. VEC models showed unidirectional causality from financial development to economic development in two countries namely Benin and Ghana. On the other hand, in four countries namely Cameroon, Mauritius, Nigeria and Togo unidirectional causality was found from economic growth to financial development and bi-directional casualty was found in six countries namely Ethiopia, Kenya, Malawi, Rwanda, South Africa and Tanzania. Thus overall they found that economic development led to financial development.

Thangavelu, Jiunn and James (2004) examined the causal relationship between financial development and economic growth for Australia for the period 1960-1999. They used real GDP per capita as a proxy of economic development. The ratio of bank claims on private sectors to nominal GDP, the ratio of domestic bank deposit liabilities to

nominal GDP and the ratio of equities turnover to nominal GDP were used as proxies of the level of financial development. Money market and reserve bank discount interest rate variables were also used in models. All variables were in log form except the interest rate variables. They applied the Akaike Information Criterion (AIC) to choose the quarterly lag length of each variable in a vector autoregressive (VAR) model and Granger causality test. They constructed six models each containing three variables: an economic growth variable, one of the three financial development variables and one of two interest rate variables. They found that variables were cointegrated in these models. Results showed that the ratio of equities turnover to nominal GDP Granger-caused real GDP per capita. On the other hand, real GDP per capita Granger-caused the ratio of bank claims on private sectors to nominal GDP and the ratio of domestic bank deposit liabilities to nominal GDP. Thus, overall the results showed unidirectional causality from economic development to financial development.

Atindehou, Gueyie and Amenounve (2005) examined causality between financial variables and economic development for 12 West African countries for the period 1960-1997. They used real GDP per capita as a proxy of economic development. On the other hand they used domestic credit - the ratio of total credit to all sectors (with the exception of credit to the central government) to GDP, liquidity liability – the ratio of liquidity commitments of the financial system to GDP, and the liquidity reserve – the ratio of bank liquid reserves to bank assets as proxies of financial development. All variables were in log form. They used Engle and Granger (1987) and Granger causality methodologies. The optimal lags were determined by using the Schwarz Criterion (SC). Result showed that domestic credit, and growth and liquidity reserve, and growth were not cointegrated in the cases of Gambia and Sierra Leone, respectively. ECMs results showed that domestic credit caused growth in the cases of Mauritius and Sierra Leone. Liquidity liability caused growth in the case of Ivory Coast, Mali (in the Granger causality model), Gambia, Mauritius and Sierra Leone (in the EC model). Liquidity reserves caused growth in the cases of Ivory Coast (in the Granger causality model), and Mauritius (in the EC model). Growth caused liquidity liability in the cases of Burkina Faso and Mauritius. Growth also caused liquidity reserves in the cases of Niger, Nigeria, Sierra Leone (in the Granger causality model), Mauritius and Togo (in the EC model). In the cases of Benin, Ghana and Senegal, no causality was found between growth and financial variables.

These results were mixed in terms of the direction of causality between financial and economic development.

Ang and McKibbin (2007) examined the causality between financial and economic development variables for Malaysia for the period 1960-2001. They used the ratio of liquid liabilities (M3) to GDP, the ratio of commercial bank assets to commercial bank assets plus central bank assets, the ratio of domestic and private sector credit to nominal GDP as proxies of financial development. They also constructed a separate variable, a financial depth/development index, by using the principal components method on the above mentioned variables. They also constructed the financial repression index (the inverse of this index was interpreted as the extent of financial liberalization), which contained interest rate controls, direct credit programs, and statutory reserve requirements. For the interest rate control policy for the priority sectors they used dummy variables. The direct credit programs, statutory reserve ratio and liquidity ratio were measured in percentages. All other variables were in natural log. They also included GDP per capita, real interest rate and five dummies: the oil crises in 1973 and 1979, the global economic recession in 1985, the Asian financial crises in 1997-98 and the world trade recession in 2001. They constructed 4-variable VAR models each containing one of the four financial development variables, a financial repression index, GDP per capita and real interest rate. Each model was estimated with the lag length of one or two for all variables with an EC term (which was obtained from co-integrated vector). Results showed that growth and financial variables had a positive relationship in the normalized equation. In the short-run, no Granger causality was found between financial variables and economic growth in all models. ECM based causality results showed unidirectional causality from economic growth to financial development.

Table-2.2.1 indicates, on the whole, that the relationship between financial and economic development is unclear in terms of the direction of causality from financial development to economic development. Thus, the effectiveness of financial development policies in terms of economic development is also unclear. On the other hand, there is also no separate study for Pakistan, which explores the issue of the relationship between financial and economic development in a time series framework (the study of Calderon and Liu (2003) is a panel data study of 109 countries which includes Pakistan).

II. Methodology and Model

Our aim is (1) to determine the direction of causality between financial development and economic development, and (2) to determine whether financial development is exogenous. Financial development will be considered effective if financial development is on the one hand exogenous and on the other hand it significantly causes economic development.

In our case, the model contains the following variables: economic development - real per capita GDP, financial development (the ratio of domestic credit to GDP), an investment variable (total capital formation to GDP), and a real interest rate variable (the weighted average savings interest rate minus current GDP deflator) *or* a price variable (the GDP deflator).

This model is consistent with the studies of Thangavelu, Jiunn and James (2004) Christopoulos and Tsionas (2004), and Ghirmay (2004). We also used credit to private sector ratio as a proxy of financial development but the signs were not consistent with economic theory (there was the negative relationship between investment and GDP). So we did not use them to derive the Vector Error Correction terms (ECTs). These models are available in appendix-A.

Vector Error Correction modeling is used to identify the causality of financial and economic development and to establish the exogeneity of financial development. As Masih and Masih (1996) remark, co-integration cannot detect econometric exogeneity or endogeneity of variables. However, the VECM can help to discern the econometric exogeneity or endogeneity of a variable. Furthermore according to Masih and Masih (1996) and Choudhry and Lawler (1997) one can determine the direction of causality through VECM.

We use Johansen's multivariate co-integrating testing procedure to estimate Vector Error Correction terms. This procedure identifies multiple co-integration relationships (if possible). This procedure does not restrict one to a single cointegration vector as the Engle-Granger approach (1987) does.

This study adopts the two step sequential procedure as:

1. We perform the Johansen's multivariate cointegration test to identify the cointegration of variables.

2. We estimate the Vector Error – Correction model (VECM) to establish the direction of causality of variables on the on hand and exogeneity or endogeneity on the other.

We specify vector auto regression model using parameter notation from Johansen and Juselius (1990) as

$$Y_t = \mu + \pi_1 y_{t-1} + \dots + \pi_k y_{t-k} + \phi X_t + \varepsilon_t \quad t=1,2,\dots,T \quad (2.3.1)$$

Where Y_t is a P dimensional vector of left hand side variables, X_t is a vector of the right hand side variables, ε_t is the usual error term that is distributed normally and independently with zero mean and covariance matrix Σ . The matrices π_1, \dots, π_k of the parameters contain the coefficients of left hand side variables, ϕ contains the coefficients of the right hand side variable and μ is a vector of constants. Due to non-stationarity of all variables under consideration at levels, we express the VAR in (2.3.1) in first-difference form. If cointegration exists, then we specify vector error correction models (VECMs) as:

$$\Delta y_t = r_1 \Delta y_{t-1} + \dots + r_{k-1} \Delta y_{t-k+1} + \pi y_{t-k} + \phi X_t + \mu + \varepsilon_t \quad (2.2)$$

Where

$$r_i = -(I - \pi_1 - \dots - \pi_i), \quad (i = 1, \dots, k-1)$$

$$\pi = -(I - \pi_1 - \pi_2 - \dots - \pi_k) \quad (I \text{ is an identity matrix})$$

Johansen's methodology consists of testing the rank of π , which establishes the number of co-integrating vectors. Three possible cases may arise. These cases are defined as:

- (i) Rank (π) = 0 - π is a null matrix. In this case, the traditional methods of first difference VAR are appropriate.
- (ii) Rank (π) = P - π is a full rank matrix. In this case, a VAR in level form is suitable.
- (iii) Rank (π) = $r < P$ - π is not a full rank matrix. Thus, the coefficient matrix can be written as $\pi = \alpha\beta$, where α and β are each matrices of dimension $P \times r$.

We compute the eigenvalues λ_i , ($i=1, \dots, P$) of the matrix π . We use the λ trace statistic⁹ to identify the number of co-integrating vector(s). This test statistic was developed by Johansen (1988) and is used to test the null hypothesis that at most r co-integrating vectors exist against the alternative that the number is more than r vectors.

We also use the test statistic $\lambda \max$ ¹⁰. This statistic is used for testing the null hypothesis that at most r cointegrating vectors exist against the alternative that there are $r+1$ vectors. We use the critical values of Usterwald – Lenum (1992) for both tests.

In our case, the model contains four variables: an economic development variable, a financial development variable, investment variable and an interest rate variable or a price variable. All variables are log form except the interest rate variable.

⁹ $\lambda \text{ trace } (r) = T \sum_{i=r+1}^n I_n(1-\lambda_i)$.

¹⁰ $\lambda \text{ max } (r, r+1) = -T \ln (1-\lambda_{r+1})$.

III. Results

The first step in the VEC analysis is to test the stationary properties of the variables under consideration. Table-2.4.1 presents the Augmented Dickey Fuller test. This indicates that all variables are stationary at first difference.

The next step is to find the order of vector auto regression. The Schwarz criterion and Akaike information criteria identify VAR (1) and VAR (2) for the model with respect to r and P , respectively. For testing the number of co-integrating vectors, Table-2.4.2 and 2.4.3 provide λ max and λ trace statistics at 95% critical values. With reference to r and P , both of these test statistics support the hypothesis of one cointegrating vector¹¹.

The co-integration also implies dynamic error correction models (VECMs). Results from VECMs are presented in Tables-2.4.4 and 2.4.5. A general to specific approach using at most 10% level of significance determines the optimal lag structures in the VECMs. This approach is consistent with Ghirmay (2004). Diagnostic statistics of the VECMs are provided in the last two columns of Tables-2.4.4 and 2.4.5. These statistics indicate no serial auto-correlation and specification problems in the model. The significance of the lagged error correction term (ECT) implies causality from all right hand side variables to the left-hand side variable. Furthermore, the significance of the ECT also implies econometric endogeneity of left hand side variable in the given model (Masih and Masih 1996; Choudhry and Lawler 1997).

Results for the VECM with reference to r are presented in Table-2.4.4. The insignificance of the ECTs in the deposit ratio and per capita real GDP equations indicate that these variables are exogenous in the given model. These results also indicate that the deposit ratio and per capita GDP variables cause interest rate and capital formation significantly as a component of the long term cointegrating relationship embodied in

¹¹ Normalized cointegrating equations:

$$Y_r = 1.389753D + 1.765832I + 0.044207r.$$

(12.54) (5.81) (6.66)

Log likelihood ratio: 125.6198

$$Y_r = 1.14817D + 3.413841I - 0.598748p.$$

(6.33) (6.33) (-5.36)

Log likelihood ratio: 189.37

This study also estimated other models but these models were difficult to interpret since they were not consistent with economic theory in terms of the signs of variables. These normalized equations are presented in the appendix-A.

the ECTs. The insignificance of the ECTs in the deposit ratio and per capita GDP equations also indicate that other variables in the model do not cause the deposit ratio and per capita GDP. Thus, on the one hand, financial development and economic development are found to be econometrically exogenous and no causality exists between financial development and economic development on the other. Furthermore, significant ECTs in the interest rate and investment equations indicate that the bi-directional causality exists between them. In the short run, the deposit ratio causes per capita real GDP (as evidenced by the significance of the 'F' statistics of the deposit ratio variables in the per capita GDP equation). Thus, in the short run, unidirectional causality exists from financial development to economic development.

Results for the VECM with reference to p are presented in Table-2.4.5. These results indicate that the lagged error correction terms are significant in the deposit ratio, price and capital formation equations. Thus, these three variables are found to be econometrically endogenous in this model. The significance of the ECTs in the deposit ratio, price and capital formation equations also indicate that per capita real GDP in the model does cause the deposit ratio, prices and capital formation. Thus, unidirectional causality exists from economic development to financial development. On the other hand, in the short run, the price level and deposit ratio do not cause per capita GDP. Price level and per capita GDP cause deposit ratios and capital formation (as evident in the significance of the 'F' statistics of the price and real per capita GDP variables in the deposit and capital formation equations). Thus, in the short run, unidirectional causality also exists from economic development to financial development

Comparison with Other Studies

The estimated results are consistent in terms of one-way causality from economic development to financial development with Cameroon, Togo, Mauritius, Nigeria (Ghirmay 2004) and Australia (Thangavelu, Jiunn and James 2004) and Burkina Faso, Mauritius, Niger, Mauritius, Togo (Atindehou, Gueyie and Amenounve 2005) and Malaysia (Ang and McKibbin 2007). These estimated results are also consistent with the panel data of Greece, Thailand, Philippines, Korea, India and Egypt (Arstis, Demetriades, Fattouh and Mouratidis 2002). The estimated results are consistent in terms of no causality between economic development and financial development with Benin, Ghana and Senegal (Atindehou, Gueyie and Amenounve 2005).

IV. Conclusion

This study attempted to discern the relationship between economic and financial development for Pakistan for the period 1973 - 2006. Vector error-correction modeling is used to identify the causality between economic and financial development and exogeneity of the variable(s) in the model. These error correction terms have been derived from Johansen's multivariate co-integrating procedure. Financial development could be considered effective if financial development is on the one hand exogenous and on the other hand it causes economic development – per capita real GDP.

VECM (with reference to real interest rate) indicates that no causality exists between economic development and financial development. However, only in short run financial development causes economic development (as evidenced in the significance of the 'F-statistics).

VECM (with reference to price level) indicates economic development causes financial development variable. This result is also supported by short run analysis (as evidenced in the significance of the 'F-statistics).

Furthermore, real output is found exogenous in both models. Thus, overall, financial development is ineffective in influencing real output in Pakistan.

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Table-2.2.1. Summary: Empirical Studies of Financial and Economic Development

Study	Variables	Country	Causal relationship	Level form Impact
Arestis and Demetriades (1997)	the ratio of bank deposit to nominal GDP (FD), real GDP per capita (ED), real deposit rate (r), capital stock per head and a summary measure of financial repression (FR)	South Korea	-	FD and ED (+)
Arestis and Demetriades (1997)	real GDP per capita (ED), the ratio of stock market capitalization to GDP (SD), an index of stock market volatility (V), the ratio of domestic bank credit to nominal GDP(FD)	USA	-	FD and ED (+) FD and SD (+)
Arestis and Demetriades (1997)	real GDP per capita (ED), the ratio of stock market capitalization to GDP (SD), an index of stock market volatility, the ratio of M2 to nominal GDP(FD)	Germany	-	FD and ED (+) FD and SD (+)
Arestis, Demetriades, Fattouh and Mouratidis (2002)	the ratio of nominal liquidity to nominal GDP (FD), the ratio of real GDP to population (ED), real interest rate (r) and the summary variable of reserve and liquidity (FR).	Greece Thailand Philippines Korea India Egypt	ED FD	FD and ED (+)
Calderon and Liu (2003)	The ratio of the difference in deflated broad money (M2) by CPI to real GDP (FD) and the difference in deflated credit by CPI to real GDP (FD), Real GDP per capita growth rate(ED)	22 industrial and 87 developing countries including Pakistan	FD ED	-
Christopoulos and	the ratio of total bank deposits liabilities to	In the case of Dominican	FD ED	FD and ED (+)

Tsionas (2004)	nominal GDP (FD), GDP at constant price (ED), the share of fixed capital to nominal GDP and inflation rate	Republic and panel data of 10 developing countries			
Ghirmay (2004)	Log of real GDP increment (ED). The level of credit to the private sector by (FD)	Cameroon, Togo, Mauritius, Nigeria, Benin, Ghana, Ethiopia, Kenya, Malawi, Rwanda, South Africa, Tanzania.	ED (4cases)	FD (2cases)	FD and ED (+)
Study	Variables	Country	Causal relationship		Level form Impact
Thangavelu, Jiunn and James (2004)	Real GDP per capita (ED), the ratio of bank claims on private sectors to nominal GDP, the ratio of domestic bank deposit liabilities to nominal GDP and the ratio of equities turnover to nominal GDP were used as proxies of the level of financial development (FD in alternative from). Money market, reserve bank discount interest rate variables (in alternative forms)	Australia	ED (FD only in the model of equity ratio)	FD ED	-
Atindehou, Gueyie and Amenounve (2005)	real GDP per inhabitant as a (ED), domestic credit to GDP (FD), the ratio of liquidity commitments of financial system to GDP (FD1) and the ratio of bank liquid reserves to bank assets (FD2)	Ivory Coast, Mauritius, Mali, Sierra Leone, Gambia, Mauritius, Sierra Leone, Ivory Coast,	FD1 (5cases)	ED (2cases)	-
			FD2 (2cases)	ED (2cases)	
			ED	FD1	

0.754608	r=0	R=1	74.0431	68.52	r=0	r≥1	42.49307	33.32
			2					
0.454273	r≤1	R=2	31.5500	47.21	r≤1	r≥2	18.17472	27.14
			5					
0.275093	r≤2	R=3	12.7753	29.68	r≤2	r≥3	9.973004	21.07
			2					
0.986430	r≤3	R=4	2.80226	15.41	r≤3	r≥4	2.802261	14.9
			1					

Table-2.4.3. Testing the rank of Π (with reference to P)

Eigenvalue	H ₀	H ₁	Trace Statistics	95%	H ₀	H ₁	Lamda Statistic	95%
0.884411	r=0	R=1	97.7321	68.52	r=0	r≥1	56.1006	33.32
0.520978	r≤1	R=2	41.6314	47.21	r≤1	r≥2	19.1362	27.14
0.324732	r≤2	R=3	22.4952	29.68	r≤2	r≥3	10.2087	21.07
0.253133	r≤3	R=4	12.2864	15.41	r≤3	r≥4	7.5885	14.9
0.165304	r≤4	R=5	4.6978	3.76	r≤4	r≥5	4.6978	8.18

Table-2.4.4. VECMs with reference to r

	Lagged differences			Error Correction Terms			
	ΔYr	ΔD	ΔI	Δr	ECT	LM	RESET
ΔYr	1 (3.45)***	1 (3.45)***	-	-	0.01 (0.93)	128	1.01
ΔD	-	-	1 (7.07)**	-	-0.007 (-0.19)	1.03	0.90
ΔI	3 (3.76)**	-	-	1 (3.29)**	-0.17 (-4.25)*	2.01	6.75
Δr	-	-	-	1 (3.84)**	8.52 (2.80)*	1.58	2.52

Notes: The ECTs were derived by normalizing one or more co-integrating vectors on y_t . The VECMs are based on an optimally determined criteria (general to specific (Ghirmay 2004)) lag structure and a constant. F-Statistics are in parenthesis. ***, ** and * indicate significance at the 10%, 5% and 1% levels, respectively. LM is serial correlation test with 2 lag terms. RESET is Ramsey specification error test with 2 fitted terms.

Table-2.4.5. VECMs with Reference to Lagged differences Error Correction Terms

	ΔY_r	ΔD	ΔI	Δp	ECT	LM	RESET
ΔY_r	-	-	1 (3.80)***	-	0.004 (0.04)	4.95	0.89
ΔD	1 (3.88)***	-	2 (5.62)**	2 (3.44)**	0.17 (3.3)***	0.07	5.5
ΔI	3 (5.50)*	1 (3.9)***	-	1 (5.15)*	0.14 (4.26)*	0.70	2.79
Δp	-	1 (4.45)*	-	-	-1.01 (4.75)*	0.67	3.11

See footnote: Table-2.4.4

Appendix

The following cointegration models are inconsistent with economic theory in terms of negative significant sign of total capital formation:

Yr	I	C	r.
	1.047511	-1.06821	-0.86759
	-0.32678	-0.13939	-1.14024

(std.err. in 3rd row of the table)

Yr	I	C	P
1	1.441335	-1.31893	-0.37321
	-0.32223	-0.14995	-0.07355

(std.err. in 3rd row of the table)

Note: C is credit to private sector.

Causality between Energy Consumption and Economic Growth: The Case of Pakistan

Qazi Muhammad Adnan Hye* and Sana Riaz

Abstract

This study seeks to determine the direction of causality between energy consumption (EC) and economic growth (EG), using annual data from 1971 to 2007. In our empirical analysis, we implement a bounds-testing approach to co-integration and an augmented form of the Granger causality test to identify the direction of the relationship between these variables both in the short and long run. Our findings suggest bidirectional causality between EG and EC in the short run; in the long run we find unidirectional causality from EG to EC. EC does not lead to EG in the long run because higher energy prices (oil prices) increase the cost of business, leading to a negative effect on EG. Additionally, when energy prices fluctuate, they create uncertainty that also affects economic growth. The study recommends direct investment in local energy resources.

JEL Classification: O10, C1.

Keywords: Economic Growth, Energy Consumption, Pakistan.

1. Introduction and Literature Review

Energy plays a crucial role in the economic development of a country. It enhances the productivity of factors of production and increases living standards. It is extensively recognized that economic development and energy consumption are interdependent.¹² The energy crisis of the 1970s and persistently high energy prices, particularly oil prices, have had a significant impact on the economic activity of developing economies. The key question in energy economics, however, is whether economic growth (EG) leads to energy consumption (EC) or whether EC leads to EG. Although the causal relationship between EC and economic growth (EG) has been widely studied over the last 3 decades,

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¹² See Alam and Butt (2002).

the empirical evidence is not without controversy. Using regression analysis, Pachauri (1977) and Tyner (1978) found that there was a strong correlation between economic development and EC in India. Yu and Choi (1985) estimated the casual relationship between the EC and gross national product (GNP) of five countries, concluding that there was unidirectional causality from EC to GNP in the Philippines, and reverse causality from GNP to EC in South Korea, but no causality in the USA, UK, and Poland. Cheng (1995 and 1997), employing a multivariate approach, concluded that there was no evidence of causality from EC and capital to EG in the USA, Mexico, and Venezuela. Stern (2000) found a co-integrated relationship between gross domestic product (GDP), capital, labor, and EC in the USA.

In the case of Pakistan, Riaz (1984) investigated the relationship between EC and EG using log linear regression analysis. The regression analysis of the energy-growth relationship has shown independence between socioeconomic variables and EC. Masih and Masih (1996) found a co-integrated relationship between EC and GDP in India, Pakistan, and Indonesia, but no such evidence in the case of Malaysia, Singapore, and the Philippines. Yang (2000) investigated the causal relationship between GDP and EC—including that of coal, natural gas, and electricity—analyzing the aggregate as well several disaggregated categories and found a bidirectional causality between total EC and GDP in India; in the case of Pakistan and Indonesia, GDP was found to cause EC. Anjum and Butt (2001) found that EG caused total EC, but further investigation indicated that EG did not lead to growth in petroleum consumption, while in the case of the gas sector, neither EG nor gas consumption affected each other. In the power sector, however, electricity consumption was found to lead to EG without feedback. Finally, EC was found to directly cause employment. Alam and Butt (2002) concluded that EC, EG, capital, and labor were co-integrated and that causality ran from EC to EG in the short and long run.

The objective of this paper is to re-estimate the causality between EC and EG in Pakistan as a developing economy, by employing the recently advanced co-integration technique. Section II describes data and methodology, Section III discusses empirical results, followed by a conclusion and policy implications in Section IV.

2. Data and Methodology

This study uses annual data from 1971 to 2007. GDP is measured in millions of Pakistan rupees and EC in kiloton (kt) of oil equivalent. GDP is used as a proxy variable for EG. Data for both variables are taken from World Development Indicators.¹³ This empirical analysis adopts a three-stage procedure to test the direction of causality between EC and EG.

In the first stage, the integration order of the variables is established by implementing the Ng-Perron (2001) unit root test.¹⁴ In describing the Ng-Perron unit test, we start with the augmented Dickey-Fuller (ADF) test.¹⁵

$$\Delta y_t = \alpha y_{t-1} + x_t' \delta + \beta_1 y_{t-1} + \beta_2 \Delta y_{t-2} + \dots + \beta_p \Delta y_{t-p} + v_t \quad 1$$

The null hypothesis of a unit root involves testing $\alpha = 0$ against the alternative hypothesis $\alpha < 1$ using the conventional t-test. Since the statistic does not follow the conventional student's t-distribution, Dickey and Fuller (1979) and Mackinnon (1996), among others, simulate the critical values. The ADF tests, can include a constant and / or a linear time trend. Elliot, Rothemberg and Stock (ERS hereinafter) (1996) modify the ADF tests for two cases-one with a constant and the other with a constant and a trend, as follows. First, a quasi-difference of y_t is defined. The quasi-difference of y_t depends on the value of α representing the specific point against which the null hypothesis below is tested.

$$d\left(\frac{y_t}{\alpha}\right) = y_t \text{ if } t = 1 \text{ and } d\left(\frac{y_t}{\alpha}\right) = y_t - \alpha y_t \text{ if } t > 1$$

Second, quasi-differenced data $d(y_t/\alpha)$ is regressed on the quasi-difference as follows:

$$d\left(\frac{y_t}{\alpha}\right) = d\left(\frac{x_t}{\alpha}\right)' \delta(\alpha) + \eta_t \quad 2$$

¹³ EG and EC are transformed into natural logarithms prior to econometric estimates.

¹⁴ The advantages of the Ng-Perron tests are that it allows a good size and power, and is particularly suitable for small samples.

¹⁵ Dickey and Fuller (1979, 1981).

Where x_t contains a constant or a constant and a trend. Let $\hat{\delta}(a)$ be the OLS estimate of $\delta(a)$. For a, the ERS method recommends using $\alpha = \bar{\alpha}$ where $\bar{\alpha} = 1 - 7/T$ if $x_t = \{1\}$ and $\bar{\alpha} = 1 - 13.5/T$ if $x_t = \{1, t\}$. GLS detrended data, y_t^d , are defined as follows: $y_t^d \equiv y_t - x_t'$. According to the ERS method, GLS detrended y_t^d substituted for y_t .

$$\Delta y_t^d = \alpha \Delta y_{t-1}^d + \beta_1 \Delta y_{t-2}^d \Delta y_{t-1} + \dots + \beta_p \Delta y_{t-p}^d + v_t \quad 3$$

As in the ADF test, the GLS unit root test involves the test on the coefficient a. The ERS point optimal test is as follows. Let the residuals from equation (2) be $\hat{\eta}_t(a) = d(y_t/a) = d(x_t/a)' \hat{\delta}(\bar{\alpha})$ and let the sum of squared residuals, $SSR(\alpha) = \hat{\eta}_t^2(\alpha)$. The null hypothesis for the point optimal test is $\alpha = 1$ and the alternative hypothesis is $\alpha = \bar{\alpha}$. The test statistic is $P_t = (SSR(\bar{\alpha}) - SSR(1))/f_0$ where f_0 is an estimator of the residual spectrum at frequency zero. The four Ng-Perron tests involve modifications of the following four unit root tests: Phillips-Perron Z_a and Z_t , Bhargava R_1 , and the ERS optimal point test. The tests are based on GLS detrended data, Δy_t . First, let us define

$$k = \sum_{t=2}^T (y_{t-1}^d)^2 / T^2.$$

The four statistics are listed below:

$$MZ_{\alpha}^d = ((T^1 y_T^d)^2 - f_0) / 2k$$

$$MZ_{\tau}^d = MZ_{\alpha} \times MSB$$

$$MSB^d = (k/f_0)^{1/2}$$

$$MP_{\tau}^d = (\bar{c}^2 k - \bar{c} T^1) (y^d T)^2 / f_0 \text{ if } x_t \quad 4$$

$$\text{and} \quad MP_{\tau}^d = (\bar{c}^2 k + (1 - \bar{c}) T^1) (y^d T)^2 / f_0 \text{ if } x_t = \quad 5$$

$$\text{Where} \quad \bar{c} = -7 \text{ if } x_t = \{1\} \text{ and } \bar{c} = -13.5 \text{ if } x_t =$$

As with most other tests, the null hypothesis of the unit root cannot be rejected if the test statistic is higher than the critical value.

The second stage involves testing for the existence of a long-run relationship between EG and EC within a univariate framework. In the last two decades, several econometric procedures have been employed to investigate the co-integrated relationships among macroeconomic variables. With regard to univariate co-integration approaches, there are several examples, including Engle and Granger (1987) and the fully modified OLS procedures of Phillips and Hansen (1990). There are also many examples of multivariate co-integration procedures, including Johansen (1988), Johansen and Juselius (1990), and Johansen's (1996) full information maximum likelihood technique.

A recently advanced co-integration approach, known as the autoregressive distributed lag (ARDL) [Pesaran et al (2001)], has become popular among researchers. In Pesaran et al (2001), the co-integration approach, also known as the bounds testing method,¹⁶ is used to test the existence of a co-integrated relationship among variables. The procedure involves investigating the existence of a long-run relationship in the form of an unrestricted error correction model for each variable as follows:

$$\Delta \ln(EG)_t = \lambda_{0EG} + \sum_{i=0}^n \lambda_{iEG} \Delta \ln(EG)_{t-i} + \sum_{i=0}^n \lambda_{iEG} \Delta \ln(EC)_{t-i} + \alpha_{1EG} \ln(EG)_{t-1} + \alpha_{2EG} \ln(EC)_{t-1} + v_{1t} \quad 6$$

$$\Delta \ln(EC)_t = \lambda_{0EC} + \sum_{i=0}^n \lambda_{iEC} \Delta \ln(EC)_{t-i} + \sum_{i=0}^n \lambda_{iEC} \Delta \ln(EG)_{t-i} + \alpha_{1EC} \ln(EC)_{t-1} + \alpha_{2EC} \ln(EG)_{t-1} + v_{2t} \quad 7$$

Where $\ln(EG)$ is the natural logarithm of GDP, and $\ln(EC)$ is the natural logarithm of EC. The F-tests are used to test the existence of long-run relationships. The F-test used for this procedure, however, has a nonstandard distribution. Thus, the Pesaran et al (2001) approach

¹⁶ It has certain econometric advantages compared with other single co-integration procedures. They are as follows: i) endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger method are avoided; ii) the long and short-run parameters of the model in question are estimated simultaneously; iii) the ARDL approach to testing for the existence of a long-run relationship between the variables in levels is applicable irrespective of whether the underlying regressors are purely $I(0)$, purely $I(1)$, or fractionally integrated; iv) It is superior in small sample.

computes two sets of critical values for a given significance level. One set assumes that all variables are $I(0)$ and the other set assumes they are all $I(1)$. If the computed F-statistic exceeds the upper critical bounds value, then the H_0 (null hypothesis) is rejected. If the F-statistic falls within the bounds set, then the test becomes inconclusive. If the F-statistic falls below the lower critical bound value, it implies no co-integration. When a long-run relationship exists, the F-test indicates which variable should be normalized. The null hypothesis of equation (6) is $\langle H_0 = \alpha_{1EG} = \alpha_{2EG} = 0 \rangle$. This is denoted as $F_{EG} \langle Ln(EG) | Ln(EC) \rangle$. In equation (7), the null hypothesis is $\langle H_0 = \alpha_{1EC} = \alpha_{2EC} = 0 \rangle$, which is represented by $F_{EC} \langle Ln(EC) | Ln(EG) \rangle$.

The third stage entails forming standard Granger-type causality tests augmented by a lagged error-correction term. The Granger representation theorem suggests that there will be Granger causality in at least one direction if there exists a co-integrated relationship among the variables in equations (6) and (7), providing that they are integrated to the order of 1. Engle and Granger (1987) show that the Granger causality test, which is conducted in first difference via a vector auto-regression (VAR), will be misleading in the presence of co-integration. Therefore, including an additional variable in the VAR system, such as an error-correction term, helps capture the long-run relationship. An augmented form of the Granger causality test involving an error-correction term is formulated in a vector error-correction model (VECM), as follows:

$$\begin{bmatrix} \Delta \ln EG \\ \Delta \ln EC \end{bmatrix} = \begin{bmatrix} \Gamma_1 \\ \Gamma_2 \end{bmatrix} + \sum_{i=1}^p \begin{bmatrix} n_{11i} & n_{12i} & n_{13i} \\ n_{21i} & n_{22i} & n_{23i} \end{bmatrix} \begin{bmatrix} \Delta \ln EG_{t-i} \\ \Delta \ln EC_{t-i} \end{bmatrix} + \begin{bmatrix} \Omega_1 \\ \Omega_2 \end{bmatrix} [EC_{t-1}] + \begin{bmatrix} \Psi_1 \\ \Psi_2 \end{bmatrix} \quad 8$$

EC_{t-1} is the error correction term that is derived from the long-run relationship. The Granger causality test can be applied to equation (8) as follows: (i) by checking the statistical significance of the lagged differences of the variables for each vector: this is a measure of short-run causality; and (ii) by examining statistical significance of the error-correction terms for the vector which shows the existence of a long-run relationship.

3. Empirical Results

All time series data show some trend. When working with time series data, the first question to ask is whether or not the series is

stationary. A stochastic process is said to be stationary if its mean and variance are constant over time, and if the covariance exists between the two time periods and not the actual time at which the covariance is computed. To test the stationary of the variables the Ng-Perron unit root test is applied for EC and EG.¹⁷ The results of Table-1 indicate that $\ln(\text{EG})$ and $\ln(\text{EC})$ are I (1) variables at a 1% significance level.

¹⁷ Mostly in literature, the order of integration explore by using the ADF (Dickey & Fuller, 1979) and P-P (Philip & Perron, 1988) unit root tests. Due to their poor size and power properties, both tests are not reliable for small sample data set (Dejong et al, 1992 and Harris, 2003). So this study uses Ng-Perron unit root test.

Table-1: Ng-Perron Unit Root Test

Ng-Perron at Level with Constant and Trend				
	MZa	MZt	MSB	MPT
$\ln(EC)$	-1.25	-0.48	0.38	36.42
$\ln(EG)$	-8.38	-1.89	0.22	11.33
Ng-Perron at 1st Difference With Constant and Trend				
$\Delta \ln(EC)$	-21.21*	-3.24	0.15	4.35
$\Delta \ln(EG)$	-568.62*	-16.81	0.02	0.24

* Significant at 1%.

Equations (6) to (8) were estimated in two stages. In the first stage of the ARDL producer, the order of lags on the first differenced variables was obtained from unrestricted VAR by means of the Akaike Information Criterion (AIC) and Schwarz-Bayesian Criterion (SBC). Both lag selection criterion indicates that the optimal lag level is 3 years.

Table-2: Lags Selection Criterion

Lag	AIC	SBC
1	-2.86	-2.77
2	-10.14	-9.80
3	1) -10.27*	2) -9.81*

An F deletion test was applied to equations (6) and (7) in order to test the existence of a long-run relationship. The results of bounds testing are presented in Table-3. As can be seen in Table-3, it is clear that there is a long-run relationship between the variables when EC is the dependent variable because its F-statistic exceeds the upper bound critical value at a 5% level of significance. The null hypothesis of equation (6) however, cannot be rejected. Thus, the bounds test result confirms that long-run unidirectional causality runs from EG to EC. At the bottom of Table-3, the estimate of the co-integrated equation shows a positive elasticity (equal to 0.33) for EC with respect to EG.

Table-3: Calculated F-Statistic¹⁸

	Lag 2	Lag 3
$F_{EG} \langle \text{Ln}(EG) \text{Ln}(EC) \rangle$	1.48	0.94
$F_{EC} \langle \text{Ln}(EC) \text{Ln}(EG) \rangle$	5.11	6.55
Long-Run Elasticity (Co-Integrated Equation)		
$\text{Ln}(EC) = 1.69 + 0.33 \text{Ln}(EG)$		
T-ratio (8.87) (46.94)		

Table-4 shows the results of short- and long-run Granger causality within the VECM framework. The short-run causal effects are demonstrated through the F-statistics of the explanatory variables and long run causality is tested with the help of statistical significance and sign of the error correction term. The coefficient of the lagged error-correction term is significant (at a 1% level of significance) with the expected sign (negative), when the $\ln(EC)$ is the dependent variable, which is also confirmed by the result of the bounds test.

Table-4: Granger Causality Test

Dependent Variable	F-statistics		
	$\Delta \ln(EG)$	$\Delta \ln(EC)$	(ECM)_{t-1}(t-statistic)
$\Delta \ln(EG)$	-	10.52 (0.00)	-0.33 (0.35)
$\Delta \ln(EC)$	3.25 (0.05)	-	-0.13 (0.00)
Causality Inference: $EC \Rightarrow EG$ and $EG \Rightarrow EC$ in the short run			
$EG \Rightarrow EC$ in the Long run			

This implies that EG Granger causes EC in the long run and that the direction of causality runs interactively through the error-correction term. On other hand, there is bidirectional causality between EC and EG in the short run.

¹⁸ The critical value ranges of F-statistics are 3.96 – 4.53 and 3.21 – 3.74 at 5% and 10% level of significances, respectively. See Paresh Kumar Narayan (2005).

4. Conclusion and Policy Implications

The objective of this study was to determine the direction of causality between EG and EC, by using the co-integration approach known as the Autoregressive Distributed Lag (ARDL) [Pesaran et al (2001)] and an augmented form of the Granger causality test. Our main findings were as follows. First, we found that, by using the ARDL, there was one co-integrated relationship between the two variables when EC was the dependent variable. Second, we investigated the direction of causality between the variables using the Granger causality-testing procedure, and found that changes in EG cause changes in EC in the short- and long run. Moreover, EC will cause EG in the short run but not in the long run.

Our findings have the following policy implications. EC in the form of oil consumption will Granger cause EG only in the short run, not the long run. On the other hand, EG will increase EC. Pakistan initially met only 18% of its energy needs from indigenous production, had to import the remaining 82% and pay international prices. The policy implication of this paper is that Pakistan will need to continue investing in the energy sector, particularly in natural gas, coal, wind, hydroelectricity, and nuclear power. This will reduce its import burden. On the demand side, consumers should be made aware of the importance of efficient use of oil, particularly given our finding that oil consumption does not contribute to EG in the long run.

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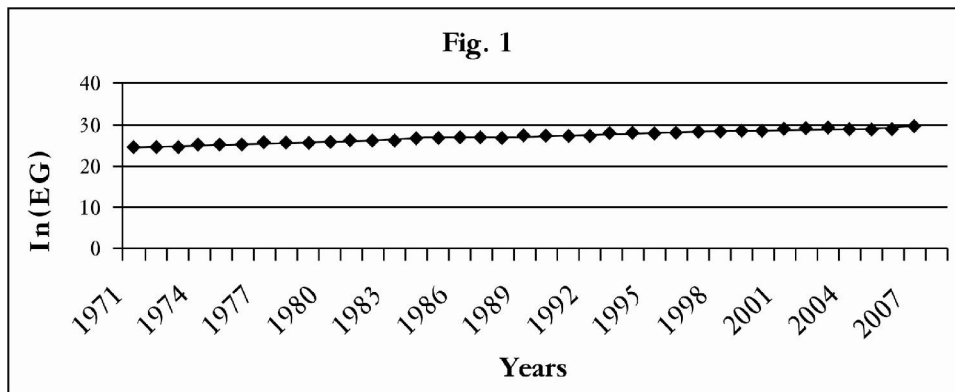
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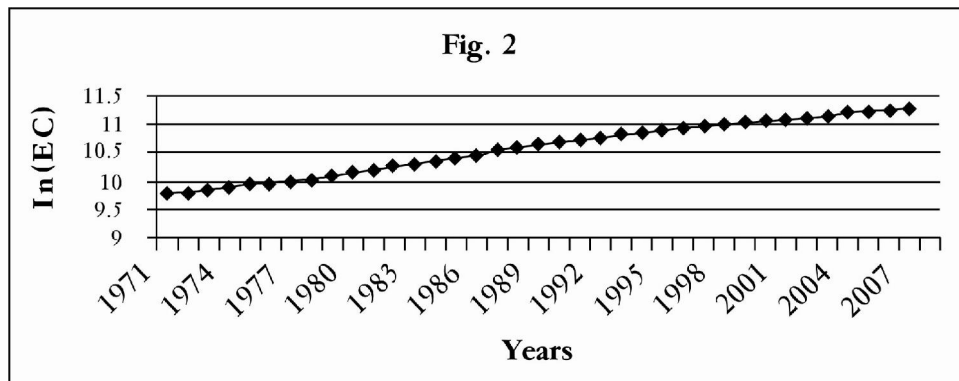
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*Appendix***A. Descriptive Statistic and Correlation Matrix**

Descriptive Statistic		
	Ln(Y)	ln(EG)
Mean	27.28	10.55
Median	27.30	10.60
Maximum	29.51	11.24
Minimum	24.64	9.76
Std. Dev.	1.469	0.47
Skewness	-0.14	-0.16
Kurtosis	1.88	1.66
Correlation Matrix		
	ln(Y)	ln(EG)
ln(Y)	1	-
ln(EG)	0.99	1

B. Natural Logarithm of Economic Growth (lnEG) and Natural Logarithm of Energy Consumption (lnEC)



Export-Led Growth Hypothesis in Pakistan: A Reinvestigation Using the Bounds Test

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Abstract

Trade is presumed to act as a catalyst to economic growth. This paper reinvestigates the export-led growth hypothesis in Pakistan by using annual time series data on exports, imports, terms of trade, and the labor force participation rate as explanatory variables and gross domestic product (GDP) as the dependent variable for the period 1971-2005. The study uses the more comprehensive and recent bounds test or autoregressive distributed lag model (ARDL) proposed by Pesaran et al (2001) to examine the existence of short-run and long-run relationships between exports and economic growth, which is crucial in designing policy to enhance trade-related potential in Pakistan. The results indicate that exports, labor force, and imports have a positive effect on growth, while the terms of trade has a negative effect. The proxy for trade liberalization has a positive impact on economic growth. Finally, the chief finding of this study is that the hypothesis of export-led growth in the Pakistan economy is supported in both the short and long run. Economic growth in Pakistan is accompanied by fluctuations in exports and imports both in the short and long run, but the labor force participation rate has a negative effect only in the short run. The terms of trade has the same effect in the short and long run.

JEL Classification: C22, F49.

Keywords: Economic Growth, Exports, Imports, Labor Force Participation.

Introduction

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Trade is presumed to act as a catalyst to economic growth in the sense that it can contribute to a more efficient allocation of resources within countries as well as transmit growth across countries and regions. Trade is a vehicle for the transmission of new ideas, technology, and managerial skills. The insight into the dynamic gains from trade is provided by a wide variety of theoretical models in the tradition of endogenous trade theories. The impact of trade policy, especially import substitution or export promotion, on growth and development has also been debated in the relevant literature. In the 1950s and 1960s, most developing countries followed “import substitution policies” for economic growth, which stressed the need for less developed countries (LDCs) to evolve their own style of development and control their destiny by establishing domestically owned firms that could begin to produce for domestic consumption. Although it was recognized that, in all likelihood, there would be efficiency losses due to protection, the gains from increasing domestic production and movement down the cost curve would more than offset these inefficiencies.

Export-led growth is a term used loosely to refer to a strategy that encourages and supports the production of exports. The export-led growth hypothesis (ELGH) postulates that economic growth can be generated not only by increasing the amount of labor and capital within the economy, but also by expanding exports. In fact, exports are generally supposed to contribute positively to economic growth through different means: (i) facilitating the exploitation of economies of scale, (ii) relieving the foreign exchange constraint, (iii) enhancing efficiency through increased competition, and (iv) promoting the diffusion of technical knowledge¹⁹. Moreover, the growth of exports plays a major part in the growth process as it relieves a country from its balance of payment constraint by stimulating demand, encouraging savings, and capital accumulation. Exports increase the supply potential of the economy by raising the capacity to import. Hence, exports and export policies in particular are regarded as crucial growth stimulators.

Theoretical advances in the trade and growth literature have been complemented by the growing body of empirical literature that has sought to test the export-led growth hypothesis but produced results that were mixed/questionable. The theoretical agreement on export-led growth emerged among neo-classical economists after the successful story of

¹⁹ For more detail see (Helpman and Krugman, 1985), (McKinnon, 1964), (Krueger, 1980), (Grossman and Helpman, 1991).

newly industrialized countries (NICs). NICs have been successful in achieving high and sustainable rates of economic growth because of their free market- and outward-oriented economies. The foreign exchange earned from exports allows imports of capital and other intermediate goods, which increases production potential.²⁰ Emrey (1967) empirically proves that higher rates of export growth lead to higher rates of economic growth. Syron and Walsh (1968) support the hypothesis but produce results that are sensitive, depending on the type of country under scrutiny, i.e., LDCs or developed countries. Serven (1968) supports the export-led growth hypothesis.

In a cross-section analysis, Kravis (1970), Michaely (1977) Bhagwati (1978), and Heller and Porter (1978), among others, explore the relationship between exports and growth. Balassa (1978) and Krueger (1980) identify that exports increase total factor productivity because of their impact on economies of scale and other externalities.²¹ Colombatto (1990), using a sample of 70 countries, and Ahmed and Harnhirun (1996) reject the export-led growth hypothesis. Sheehey (1993) finds inconsistent evidence of higher productivity in the export sector compared with the nonexport sector. Bahmani, Oskooee, and Alse (1993) find that there is a long-run relationship between real exports and real output in LDCs. Lee and Cole (1994) and Sharma and Dhaka (1994) find a bidirectional relationship between exports and growth. Kwan and Kwok (1995) consider exports a production input. Paul and Chowdhury (1995) find evidence of causality running from exports to GDP growth. To some extent, cross-section empirical investigations can explain why growth differs across a wide spectrum of countries. However, the main criticism is directed at cross-country studies.²²

In response to these criticisms, a number of more recent econometric studies in the area of export-led growth exist for LDCs using time-series data to investigate the causal relationship between exports and growth, principally by means of Granger-type causality tests. These include the following. Fajana (1979) working on Nigeria, supports the export-led growth hypothesis and suggests that it is due to changes in domestic investment resources. Chow (1987) and Jin (1995) reveal that

²⁰ See Mckinnon (1964) and Chenery and Strout (1966).

²¹ Such as technology transfer, improving skills of workers, improving managerial skills and increasing productive capacity of economy.

²² (Shan and Sun, 1998), Cross sectional analysis ignore the shifts in the relationship between variables over time within a country, while export growth and economic growth is a long run phenomenon.

there is strong bidirectional causality in most NICs. Sun and Shan (1998) show similar results for China. Hsiao (1987) uses time-series data and rejects the export-led growth hypothesis for most LDCs in the sample used. Darrat (1987), Oskooee et al (1991), and Greenway and Sapsford (1994) find some support in favor of the export-led growth hypothesis. Sengupta (1991) supports the export-led growth hypothesis, suggesting that exports have a positive externality effect on growth. Vanden Berg and Schmidt (1994), Luis and Letelier Saavedra (1994), Dutt and Ghosh (1996), Islam (1998), Begum, Shamshad, and Shamsuddin (1998), and Pereira and Xu (2000) also find evidence to support the export-led growth hypothesis.

Some recent studies on Pakistan posit that output growth has a perverse effect on export growth²³ and that countries can accelerate their economic growth by exporting manufactured goods produced with modern technologies.²⁴ Dodaro (1993) and Ahmed et al (2000) fail to find any significant relationship in either direction for Pakistan. Oskooee and Alse (1993) present strong empirical support for a two-way causality between export growth and GDP growth in eight (including Pakistan) out of nine countries. Rana (1985), and Love and Chandra (2004) argue that exports contribute positively to economic growth. Anwar and Sampath (2000) reveal a unidirectional causality in the case of Pakistan. Kemal et al (2002) find no evidence of causation in the short run in either direction. However, they find strong support for long-run causality from exports to GDP for Pakistan. Muslehuddin (2004) examines the export-led growth hypothesis for the five largest economies in South Asia, i.e., India, Pakistan, Bangladesh, Sri Lanka, and Nepal. The study finds long-run equilibrium relationships among exports, imports, and output for Bangladesh and Pakistan.

Khan and Saqib (1993) and Ashfaq Khan, and Afia (1995) find a strong relationship between export performance and economic growth in Pakistan. Mutairi (1993) finds no support for the period 1959-91, while Khan et al (1995) find strong evidence of bidirectional causality between export growth and economic growth. Shirazi and Manap (2004) strongly support a long-run relationship among imports, exports, and output growth, and unidirectional causality from exports to output growth, but no significant causality between imports and export growth. Quddus and Saeed (2005) find one-way causality running from exports to economic

²³ Jung and Marshall (1985).

²⁴ Hameed, Chaudhary and Khan (2005).

growth in the long run, with estimates that also reveal that the growth rate of exports, total investment, and labor employed have a positive effect on the GDP growth rate.

In much of the literature, exports are seen as causing growth. In developing economies such as Pakistan, which has sufficient domestic resources, export expansion still relies on importing certain goods that are not produced in the domestic market but play a key role in the manufacturing of export-driven goods. Thus, Pakistan still needs to locate and import the necessary technology in order to hold a competitive position. This implies that imports as well as exports play a vital role in economic growth. The theoretical argument is that export-orientation increases the openness of the economy and, by exposing it to foreign technology and foreign competition, provokes a rapid rate of technological progress. All in all, these authors suggest that countries with a higher export growth rate over an extended period tend to grow faster than others.

Reviewing the validity of the export-led growth hypothesis reveals mixed results due to differences in sample period and econometric techniques such as OLS, VAR, co-integration procedures, and the Granger causality framework. The OLS method is not adequate for studying causality or a co-integrated relationship, while the Engle-Granger residual based cointegration tests are inefficient and can lead to contradictory results, especially when there are more than two I(1) variables under consideration (Pesaran and Pesaran, 1997). Johansen (1988, 1991) and Johansen and Juselius (1990) use tests for the multivariate case but the above methods require that the variables in the system be of equal order of integration. These methods do not include information on structural breaks in time series data, suffer from low power, and do not have good small sample properties. Due to these problems associated with the standard test methods, the OLS-based ARDL approach to co-integration has become popular in recent years.

The motive of this paper is to test the validity of long-term and short-term linkages for export-led growth in Pakistan, using the recent and more comprehensive bounds test or ARDL proposed by Pesaran et al (2001). The study employs annual time series data (for 1971-2006) along multiple structural breaks because structural changes can change the sources of growth, and affect the export-growth relationship.

The structure of this article is as follows: Section 2 presents the model, methods used to estimate variables, data, sources of data, and the

definition of variables included in the model. Section 3 presents the estimated results. The last section summarizes the main results along with concluding remarks.

II. Model Specification and Estimation Technique

In examining the export-led growth hypothesis, we have employed the ARDL bounds test approach to co-integration analysis. The ARDL modeling approach popularized by Pesaran and Pesaran (1997), Pesaran and Smith (1998), Pesaran and Shin (1999), and Pesaran et al. (2001) has numerous advantages. The main advantage is that it can be applied regardless of the stationary properties of variables in the sample. The model allows a sufficient number of lags to capture the data generating process in a general-to-specific modeling framework (Laurenceson and Chai 2003, p. 28). Moreover, a dynamic error correction model (ECM) can be derived from ARDL through a simple linear transformation (Banerjee et al 1993, p. 51), which allows for inferences of long-run estimates, which is not possible under alternative co-integration procedures (Sezgin and Yildirim 2002). The ARDL method has the additional advantage of yielding consistent estimates of long-run parameters that are asymptotically normal, irrespective of whether the variables are $I(0)$, $I(1)$ or mutually integrated. While it is not necessary to pretest the unit root, doing so complements the estimation process to ensure that none of the variables are integrated of higher order i.e., $I(2)$. Moreover, unit root tests yield different conclusions, not only due to their different power, but also due to the different lag length selected in each test.

It also shows that appropriate lags in the ARDL are corrected for both residual correlation and endogeneity. As long as the ARDL model is free of residual correlation, endogeneity is less of a problem (Pesaran and Shin 1999). The important advantage of ARDL against the single equation co-integration analysis such as that used by Engle and Granger (1987) is that the latter suffers from problems of endogeneity while the ARDL method can distinguish between dependent and explanatory variables. Indeed, one of the important advantages of the ARDL procedure is that estimation is possible even when explanatory variables are endogenous (Alam and Quazi, 2003). Hence, the ARDL model provides robust results for small sample sizes.

In view of the above, we construct the following model:

$$\text{GDP} = \beta_0 + \beta_1 X + \beta_2 M + \beta_3 \text{TOT} + \beta_4 \text{LF} + u \quad 1$$

Where β 's are parameters, u is the error term and independent variables include X , M , TOT , and LF . The dependent variable is real GDP. For the above equation the unrestricted error correction version of the ARDL model is given by:

$$\text{GDP}_t = \beta_0 + \beta_1 \text{GDP}_{t-1} + \beta_2 X_{t-1} + \beta_3 M_{t-1} + \beta_4 \text{TOT}_{t-1} + \beta_5 \text{LF}_{t-1} + \sum_{i=1}^m \beta_6 \text{GDP}_{t-i} + \sum_{i=0}^m \beta_7 X_{t-i} + \sum_{i=0}^m \beta_8 M_{t-i} + \sum_{i=0}^m \beta_8 \text{TOT}_{t-i} + \sum_{i=0}^m \beta_9 \text{LF}_{t-i} + u \quad 2$$

The first part of the above equation represents the long-run dynamics of the model while the second part shows the short-run relationship, in which Δ is the first difference operator, u_t is a white noise disturbance term, and all variables are expressed in natural logarithms. The equation indicates that economic growth, in terms of real GDP, tends to be influenced by its past values so that it involves other disturbances or shocks. Therefore, Equation 2 was modified to capture and absorb certain economic shocks. Dummy variables (DUM) with a value of 0 before and a value of 1 after the trade liberalization period have been included in the equation to measure the impact of structural breaks in the economy.

$$\text{GDP}_t = \beta_0 + \beta_1 \text{GDP}_{t-1} + \beta_2 X_{t-1} + \beta_3 M_{t-1} + \beta_4 \text{TOT}_{t-1} + \beta_5 \text{LF}_{t-1} + \text{DUM}_t + \sum_{i=1}^m \beta_6 \text{GDP}_{t-i} + \sum_{i=0}^m \beta_7 X_{t-i} + \sum_{i=0}^m \beta_8 M_{t-i} + \sum_{i=0}^m \beta_8 \text{TOT}_{t-i} + \sum_{i=0}^m \beta_9 \text{LF}_{t-i} + u \quad 3$$

The ARDL approach involves two steps for estimating the long-run relationship (Pesaran et al., 2001). The first step is to examine the existence of a long-run relationship among all variables in the equations being estimated. The second step is to estimate the long- and short-run coefficients of the same equation. We run the second step only if we find a long-run relationship in the first step. Thus, to test the long-run relationship in Equation 3, we impose restrictions on the estimated long-run coefficients of the variables. The null and alternative hypotheses are as follows:

$$\mathbf{H}_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0 \text{ (no long-run relationship)}$$

$$\mathbf{H}_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0 \text{ (long-run relationship exists)}$$

The calculated F-statistic in this procedure has a nonstandard distribution, and is compared with two sets of critical values tabulated by Pesaran et al. (2001) i.e., to conduct bounds testing for the above equation. If the calculated F-statistic is larger than the upper bound critical value, then the null hypothesis of no co-integration is rejected irrespective of whether the variables are I(0) or I(1). If it is below the lower bound, then the null hypothesis of no co-integration cannot be rejected. If it falls inside the critical value band, the test is inconclusive. When one set assumes that all variables are I(0), the decision is based on the lower bound; when the other set assumes they are I(1), then decision is based on the upper bound.

Once co-integration is established, a lag length is selected for each variable. The ARDL method estimates $(p+1)^k$ number of regressions in order to obtain the optimal lag length for each variable, where p is the maximum number of lags used and k is the number of variables in the equation. The model can be selected using model selection criteria such the Schwartz-Bayesian criteria (SBC) or Akaike's information criteria (AIC). The AIC-based model is selected here as it has a lower prediction error than that of the SBC-based model.²⁵

In the second step, the long-run relationship is estimated using the selected ARDL model. When there is a long-run relationship between variables, there exists an error correction representation. Therefore, in the third step, the error correction model is estimated. The error correction model result indicates the speed of adjustment back to the long-run equilibrium after a short-run shock. A general error correction representation of Equation (3) is given below. (In Section III Table-5).

To ascertain the goodness of fit for the ARDL model, we conduct a diagnostic test and stability. The diagnostic test examines the serial correlation, functional form, normality, and heteroscedasticity associated with the model. The structural stability test is conducted by employing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ). Examining the prediction error of the model is another way of ascertaining the reliability of the ARDL model. If the error or the difference between the real observation and the forecast is infinitesimal, then the model can be regarded as best fitting.

²⁵ Damodar N. Gujarati, 7th Edition

Data Analysis

The variables involved in this study are real GDP, real exports, real imports, labor force participation rate, and terms of trade series. Growth of exports and reduction in imports plays a major part in the growth process as it relieves a country from the balance of payment constraint by stimulating demand, encouraging savings, and capital accumulation. The terms of trade have an important bearing on export earnings and income that has been neglected in many studies. The purpose of using the labor force participation rate is to capture its role in the economy (Pakistan being a labor-intensive country) and drawing attention to the point that an adequate supply of skilled labor leads to a higher level of economic growth.

The data for variables such as GDP, exports, imports, terms of trade, and labor force participation rate were obtained from the Economic Survey of Pakistan. We use annual time series data from 1971 to 2005. All the dependent and explanatory variables except for labor were deflated by the consumer price index (CPI), whereby the year 1999/2000 was treated as the base year (99/00 = 100). Furthermore, all the series were transformed into log form. Log transformation can reduce the problem of heteroscedasticity because it compresses the scale in which the variables are measured, thereby reducing a tenfold difference between two values to a twofold difference (Gujarati 1995).

III. Estimation Results

A unit root test is performed to ensure that none of the variables in equation (1) are integrated of the order I(2) or higher; this would render the procedure inapplicable. Augmented Dickey-Fuller (ADF) unit root test results are reported in Table-1. The order of autoregressive lags (n) is selected such that it produces non auto-correlated OLS residuals.

Table-1: Unit Root Estimation

Variables	Level		First Difference	
	Intercept and Trend	No. of Lags	Intercept and Trend	No. of Lags
Real GDP	-2.701049	1	-4.720575*	1
Real Export	-3.191203	1	-4.652737*	1

Real Import	-3.777174**	1	-4.648103	1
Terms of Trade	-2.943283	1	-6.010386*	1
Labor Force par. Rate	-0.586527	1	-	1
			3.280599***	

Note: *, **, *** represents the level of significance at 1%, 5%, 10% respectively with critical values of -4.2605, -3.5514, -3.2081 with intercept and trend at level while -4.2712, -3.5562, -3.2109 are the critical values with intercept and trend at first difference.

Since the results presented in Table-1 show that the variables are integrated of mixed order i.e., 1 or lower, we can apply the ARDL method to our model. The above table shows that real GDP, real exports, terms of trade, and labor force participation rate are stationary at I(1) and real imports is stationary at the level i.e., I(0).

The first step of of ARDL procedure is to estimate equation (3) and test for the presence of long-run relationship (co-integration) among the variables of Equation (1). Bahmani- Oskooee and Bohal (2000) have shown that the results of this first step are sensitive to lag length (m), selected in equation (2). Since we are using annual data, a shorter lag length is considered. We estimate Equation (2) by varying lag length (m) from 0 to 2 and compute the F-statistic for the joint significance of lagged levels of variables. The computed F-statistic for each order of lags is given below in Table-2.

Table-2: Lag Length Selection

Lag Order	F- Statistics
0	F(5, 23) = 2.24
1	F(5, 18) = 3.51
2	F(5, 13) = 10.33*

Note: The relevant critical value bounds for F-statistics (an unrestricted intercept and no trend) are taken from tables C1.iii in Pesaran et al. (2001). At the 99% level, the critical value bounds for F-statistics are 5.15-6.36. * indicates that the computed statistic falls above the upper bound value.

Table-2 shows that test results vary with the order of lags in the model. When the order of lags in equation (3) is 2, the computed F-statistic 10.33 is above their upper bounds 6.36 and the null hypothesis of no co-integration among the variables in equation (1) is strongly rejected

at a 1% significance level. Thus, there exists a long-run relationship among the variables in equation (1) and the total number of regressions estimated following the ARDL method in Equation (3) is $(2+1)^5 = 243$.

We can now proceed to the second stage of estimation. In the next stage, we select the optimal lag length for the ARDL model to determine its long-run coefficients. With the maximum order of lag set to 2, lag selection criteria AIC was used to select the appropriate order for the ARDL model. The long-run results presented in Table-3 indicate that that exports, imports, and labor force are positively correlated and terms of trade negatively correlated with economic growth.

**Table-3: Long-Run Estimates of Model Based on Equation 3
(Dependent Variable GDP)**

Variable	Coefficient	t-Statistic	Prob.
C	1.2565	0.3449	0.7403
D(GDP(-1))	-1.9668	-2.9558	0.0212
D(GDP(-2))	-0.6827	-2.0480	0.0798
D(GDP(-3))	-0.8450	-2.3373	0.0521
D(X)	-0.2632	-2.5473	0.0165
D(X(-1))	0.7661	3.2739	0.0136
D(X(-2))	0.3598	2.1449	0.0691
D(M)	-0.0240	-1.3873	0.1071
D(M(-1))	0.0402	1.7027	0.0960
D(M(-2))	0.0324	1.8320	0.0927
D(TOT)	-0.0801	-1.8776	0.0875
D(TOT(-1))	-0.6094	-2.6798	0.0316
D(TOT(-2))	-0.2016	-1.5906	0.1157
D(LF)	-2.8499	-2.5573	0.0377
D(LF(-1))	0.1930	0.2101	0.8396
D(LF(-2))	0.4283	0.5065	0.6280
DUM	0.1057	1.8168	0.1121
GD(-1)	1.1456	2.3592	0.0504
X(-1)	-1.8629	-2.8939	0.0204
M(-1)	-0.1219	-2.0118	0.0734
TOT(-1)	0.0851	1.3845	0.1056
LF(-1)	-1.7515	-1.7572	0.1193
R-squared	0.938827	AIC	-3.611510
Adjusted R ²	0.755309	F-statistic	3.45152
S.E. of regression	0.037907	Prob(F-stat)	0.04660
SBC	-2.574251	Durbin-Watson	2.075719

Based on the estimate for the unrestricted error correction model of ARDL, the long-run elasticities are the coefficient of the one lagged explanatory variable (multiplied by a negative sign) divided by the coefficient of the one lagged dependent variable (Bardsen, 1989). For example, in Equation (3), the long-run export and import elasticities are (β_2/β_1) and (β_3/β_1) , respectively (Table-4).

Table-4: Long-Run Estimated Coefficients

Variable	Coefficient
X	1.6260
M	0.1604
TOT	-0.0743
LF	1.5289
DUM	0.1057

The most significant factor in determining economic growth in Pakistan is exports (X), which, with an estimated elasticity of 1.626, shows that, in the long run, a 1% increase in the X leads to a 1.626% increase in economic growth. The next-most important factor in determining economic growth is the labor force participation rate: the coefficient of LF is 1.528 and statistically significant showing that, in the long run, a 1% increase in LF leads to a 1.528% increase in economic growth. The coefficient of imports (M) is 0.16044, suggesting that, in the long run, a 1% increase in M leads to a 0.16044% increase in economic growth; this shows that import goods might comprise nonconsumption items.

Interestingly, we find that the coefficient of terms of trade is inconsistent with the previous study (Jim and Chandra). Theoretically, if the Pakistani rupee depreciates (i.e., the Rs/US\$ increases in value), this will raise the competitiveness of domestic commodities, and hence encourage exports. By the same token, appreciation of the rupee is expected to deter exports. The findings of this study, however, show a negative relationship (-0.074) between these two variables, which means that the 1% increase in terms of trade will slow down economic growth by 0.074% on average. The estimated coefficient of the dummy variable shows that trade liberalization has a significant positive impact on economic growth.

Short-run effects are captured by the coefficients of the first-differenced variables in Equation (3). Next, we examine the short-run dynamics of the model by estimating the ARDL error correction representation of Equation (3). Estimates of error correction representation of the ARDL model are given below in Table-5.

**Table-5: Short-Run Disequilibrium Model (2, 1, 1, 1, 1, 1)
(Dependent Variable GDP)**

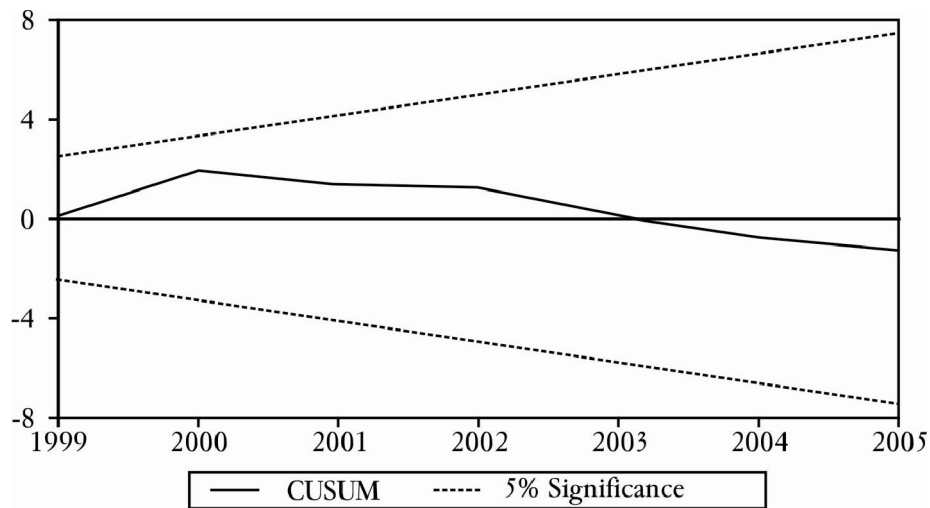
Variable	Coefficient	t-Statistic	Prob.
C	0.0370	2.1864	0.0397
GDP(-1)	0.0537	0.2566	0.7999
(X)	0.1738	2.1096	0.0465
(M)	0.0535	1.6813	0.1068
(TOT)	-0.0553	-0.7378	0.4684
(LF)	-0.1446	-0.2448	0.8089
DUM	0.0069	0.4111	0.6850
ECM(-1)	-0.3242	-2.0501	0.0525
R-squared	0.484809	AIC	-3.286385
Adjusted R ²	0.357248	SBC	-2.912732
S.E. of regression	0.041848	F-statistic	1.251571
Durbin-Watson	1.790343	Prob(F-statistic)	0.318404

An examination of the error correction model in Table-5 shows that export growth has the strongest effect on economic growth in the short run. The short-run effect of terms of trade on economic growth in Pakistan is weak and statistically insignificant at even a 10% significance level. The coefficient of the ECM term has the correct sign and is significant. It confirms a short-run relationship between the variables in equation (1). It suggests that the adjustment process is moderate. More than 32% of the previous year's disequilibrium in economic growth from its equilibrium path will be corrected in the current year. Thus, the evidence presented in this section suggests that economic growth in Pakistan is accompanied by fluctuations in exports and imports both in the short run and long run but that the labor force participation rate has a negative impact in the short run. Terms of trade have the same effect in both the short and long run.

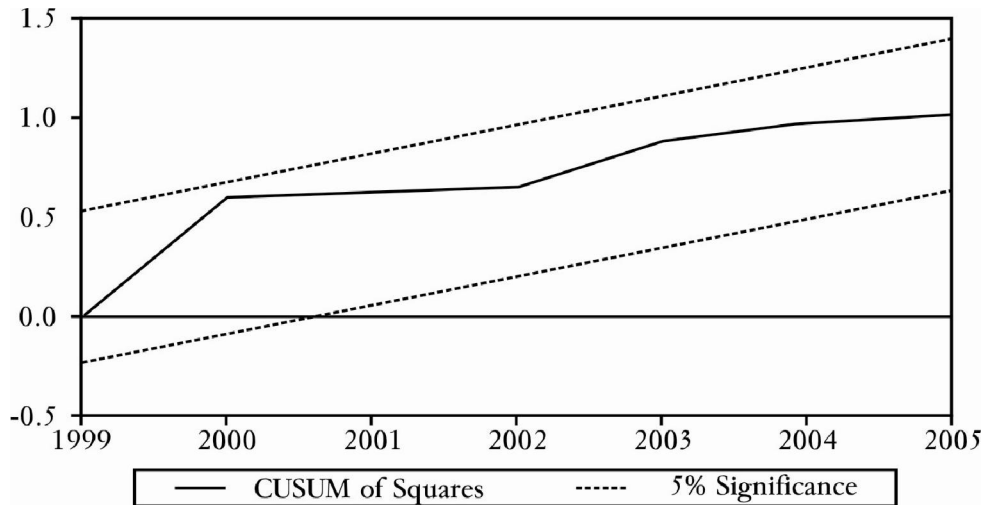
Stability and Diagnostic Test

Next, we examine the stability of the short-run and long-run coefficients. Following Pesaran and Pesaran (1977), we use the Brown et al (1975) stability testing technique, also known as the cumulative (CUSUM) and cumulative sum of squares (CUSUMSQ) tests. The CUSUM and CUSUMSQ statistics are updated recursively and plotted against the break points. If the plotted points for the CUSUM and CUSUMSQ statistics stay within the critical bounds of a 5% level of significance, the null hypotheses for all coefficients in the given regression are stable and cannot be rejected. The CUSUM and CUSUMSQ plotted points to check the stability of the short- and long-run coefficients in the ARDL error correction model (Table-5) are given below in the figure. It shows that both statistics CUSUM and CUSUMSQ are within the critical bounds, indicating that all coefficients in the ARDL error correction model are stable.

Plot of Cumulative Sum of Recursive Residuals



Plot of Cumulative Sum of Recursive Residuals



IV. Conclusion

This study adopts a different perspective, i.e., to test the relationship between exports and output growth in the Pakistan economy using the newly proposed bounds testing approach. Following the lead of trade and development theory and the aggregate production function, we have developed a conceptual model that incorporates different channels via different variables that affect the relationship between exports and economic growth. Note that this study differs from others in that it considers other important macroeconomic determinants. The ARDL model indicates that exports, labor force, and imports have a positive impact on economic growth, while the terms of trade have a negative influence on growth. The proxy for trade liberalization affects economic growth positively.

Finally, a major finding of this study is that the hypothesis of export-led growth in the Pakistan economy is supported in both the short and long run. From these findings spring several policy recommendations. First, domestic economic performance is sensitive to changes in international markets. The government should therefore implement effective macroeconomic policies in stabilizing its trade balance and liberalizing the country's trade as well as attracting export-oriented foreign direct investment into the country. We suggest export diversification away from monofactor cotton. The government should also ensure an adequate supply of well-equipped labor, as this would lead to a higher level of economic growth. Finally, a stable terms of trade policy is essential in maintaining good economic performance, as its movements can have a negative impact on economic prosperity.

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Impact of Intellectual Capital Efficiency on Profitability (A Case Study of LSE25 Companies)

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Abstract

The aim of this study is to examine the relationship between intellectual capital efficiency and the firm's profitability. The importance of intellectual capital (IC) and the related philosophy of the knowledge economy have captured the attention of researchers and business enterprises in the World Trade Organization (WTO) era. IC is widely recognized as a tool that is critical to running a successful business in a highly competitive environment. Various models have been introduced to measure the numerous facets of IC, including the Skandia navigator, Tobin's Q , and value added intellectual coefficient (VAIC). This article examines the role of IC efficiency in the firm's net profit using the VAIC developed by Ante Pulic (1998). It also investigates its correlation with the firm's profitability, using regression models.

A five-year data set for Lahore Stock Exchange Index companies (LSE-25) was obtained from audited financial reports, and used to calculate human capital, structural capital, and capital-employed efficiency of companies in different industrial sectors. The results obtained using multiple regression analysis supports the argument that IC efficiency contributes significantly to the firm's profitability. Practically, IC efficiency can be used as a benchmark and strategic indicator to direct financial and intellectual resources in the right direction, i.e., to enhance the firm's ultimate corporate value. It can also be developed as a management tool to create a sustainable comparative advantage in the competitive global knowledge economy. The study is a pioneering attempt to measure the impact of IC efficiency on net profit using cross sectional time series data.

JEL Classification: C22, C59.

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Introduction

By the end of the Second World War in 1945, most agriculture-based economies in Europe and North America had transformed into manufacturing economies, changing the focus from land and labor to financial and physical capital. Today, world economies are moving from manufacturing toward knowledge-based economic activity. Drucker (1993) indicates that knowledge is the only meaningful factor of production that is superior to land, labor, and capital. He adds that the unique contribution of management in the 20th century was the 50-fold increase in the manual worker's productivity through the conversion of labor-intensive economies into manufacturing economies. In the 21st century, management has contributed to the increase in productivity of the knowledge worker and a shift from production equipment to knowledge work. This is why many firms and even countries are planning strategies to reposition themselves in the emerging knowledge economy. In the current era of the knowledge economy, business resources comprise 20% tangible assets and 80% that are intangible (IT World, 2000). The corporate performance measurement system, however, dates back to the manufacturing era, and is heavily inclined toward financial and physical aspects, lacking relevant information on the performance of intellectual capital (IC). Thus, different ways of monitoring operations are needed to achieve maximum productivity from companies' intangible resources.

Economic managers in many countries feel that the transformation of production-based economies to knowledge-based economies is inevitable if they are to maintain the pace of economic development. For example, Malaysia's Knowledge Economy Master Plan, 2001 devises strategies to transform the country from an input-driven to a knowledge-driven economy. Naquiuddin and Heong (1992) explain that knowledge is a necessity and can be used as a strategic tool against competitors. According to Pulic (2000), IC is a moving force for business success. The vital role of knowledge is also emphasized in the *World Development Report* (1998) as "today's most technologically advanced economies are truly knowledge based." Sri Lanka, another developing country, also plans to divert its economy to a knowledge-based economy (Abeysekera, 2007). Currently, the Sri Lankan government is investing heavily to maintain its high literacy level and skilled labor force. This makes it easier for investors to maximize their return on capital (World Bank, 2004).

The Government of Pakistan is trying hard to prepare for the challenges of the knowledge economy in the globalization era. “Vision 2030,” an economic master plan, commits to increasing funds for higher education, skill development, and science and technology worth up to 1% of gross national product (GNP). This is expected to increase the proportion of qualified graduates from 4% to 20% by 2020. Amjad (2006) suggests that Pakistan could become more competitive in the global economy after investing in knowledge, technology, and new product development. Kalim and Lodhi (2005) emphasize that Pakistan must take drastic steps toward making its economy and industry more knowledge-intensive, or otherwise stand the risk of losing even its present share of world exports.

In a knowledge economy, IC is considered crucial to the competitiveness of many companies, regardless of which industry they belong to. Johnson and Kaplan (1987) argue that IC could be the most important consideration in the performance of a company. Bornemann (1999) suggests a correlation between intellectual potential and financial performance. It is natural to question why IC should be measured. The logical answer is because IC is an influential intangible strategic asset capable of transforming a national company into a multinational, even transnational corporate powerhouse in an even more competitive knowledge economy. IC measurement and management become very important when service sectors play a vital role in the growth of the global economy, and when their share in gross domestic product (GDP) rises more rapidly than that of the production sector.

The Lahore Stock Exchange (LSE), Pakistan’s second largest stock market, is an interesting case for examining the efficiency of IC in the corporate sector. A sample of LSE-25 companies was selected keeping in view that most companies with vast intellectual capital management (ICM) experience are large-scale organizations around the globe are large scale organizations around the world. Comprehensive IC performance data and disclosures are generally provided by large, publicly traded companies in their annual reports. Most investors are inclined to buy shares in LSE-25, which is why more than 90% of trading at the LSE is done in these companies (LSE Newsletter 2007). Finally, LSE-25 represents a range of industries, making it easier to generalize the findings.

This research focuses on the firm’s net profit, asking whether it changes with a change in IC efficiency using the VAIC. This method provides a standardized and straightforward measure of calculating and

comparing IC performance across various sectors at national and international levels. The method uses publicly available audited information, which is more reliable and more usable by internal and external stakeholders to check IC efficiency. The VAIC-based view of the firm gives a better insight into viewing a firm's value-creation efficiency using different IC resources. Using the VAIC index, this paper examines the association of value addition with traditional measures of profitability i.e., IC and net profit, following Mavridis (2005). The study is quantitative and based on 5-year data for 2002 to 2006, gathered from the audited annual reports of LSE-25 companies. These annual reports were gathered through direct contact, databases, LSE resources, and companies' websites. Companies in the sample cover more than five industrial sectors, making the sample representative.

Table-1: Sector-Wise Profile of LSE-25 (2006)

Sector	Firms	Years 2002-06	Firm-Years
Banks	7	5	35
Oil/Gas/Power	7	5	35
Cement	5	5	25
Chemicals/Fertilizers	2	5	10
Others	4	5	20
Total	25		125

2. Literature Review

There have been many attempts to define the term IC. Generally, IC is defined as the creative abilities of the human brain or mind. Edvinson and Malone (1997) define IC as "knowledge that can be converted into value." They also explain that the difference between market value and book value is the value of IC. Stewart (1997) views IC as knowledge, information, intellectual property, and expertise that can be put to use to create wealth. According to Bontis (2000), IC means individual workers' knowledge and organizational knowledge that together contribute to sustainable competitive advantage. He further elaborates that IC in a broad sense consists of human capital and structural capital. Pulic (2000) includes in IC, all employees' abilities that create value addition. Moore (1996) defines IC as customer capital, innovation capital, and organizational capital. On the other side of the fence are Blair and

Wallman (2001) who argue that it is difficult to give a precise definition for intangible assets as well as IC.

There are two schools of thought with regard to the measurement of IC (Mavridis, 2004). The first school focuses on cost and tries to compute IC through the difference between market and book value. The second school of thought is profit or value-oriented and focuses on measuring IC efficiency through value addition by human and structural capital. This approach appears to be the more recognized: it has been used by more than 12 researchers from different countries. The VAIC has become very popular due to its straightforward calculations, availability of reliable audited data, and easy comparison across various industrial sectors (Pulic 2004). Alternative IC measures are limited as they only be calculated by internal parties or rely on sophisticated models, analysis, and principles (Pulic 2004). On the other hand, Sveiby (1997) proposes a conceptual framework for IC that is based on external structure (brands, customer and supplier relations); internal structure (organization, structure, system corporate attitude, research and development (R&D) and procedures); and individual competence (education, experience). He argues that money must not be used as proxy for human efforts.

In relation to reporting IC, Guthrie et al (2006) refer to stakeholders and legitimacy theory. The stakeholders theory provides the right to all stakeholders to obtain information related to organizational activities and its impact on their interests, even if they do not choose to utilize that information or do not have the authority to play a constructive role in the organization (Deegan, 2000). The theory of the stakeholder includes all stakeholders, including potential and current investors, customers, creditors, employees, suppliers, government, and the public (Donaldson and Preston, 1995). The stakeholders theory creates organizational responsibility for the voluntary disclosure of information about intellectual, social, and environmental performance other than statutory requirements to make the disclosure as transparent as possible (Guthrie et al, 2006). In the same way, the legitimacy theory creates a social contract between the firm and the surrounding community in which it operates. From the perspective of this theory, a firm should voluntarily report on all those activities if the management feels that the community expects any specific report (Deegan, 2000). Legitimacy theory is closely tied to the reporting of IC (Guthrie et al, 2006).

In the developed world, the term IC is widely used by the research community. However, very few studies have used emerging economies as

a case for evaluating the implications of IC at stock exchange level. Pulic (2000) used VAIC to analyze and measure the performance of FTSE-250 companies under the London Stock Exchange. Kujansivu and Lonnqvist (2007) utilized a subordinate concept of VAIC and intellectual capital efficiency (ICE) to analyze the IC performance of 20,000 companies covering the 11 largest industries of Finland. Other studies that relate to the IC disclosure of FTSE-100 and S&P-500 companies were conducted by Williams (2001) and Robert (2000), respectively.

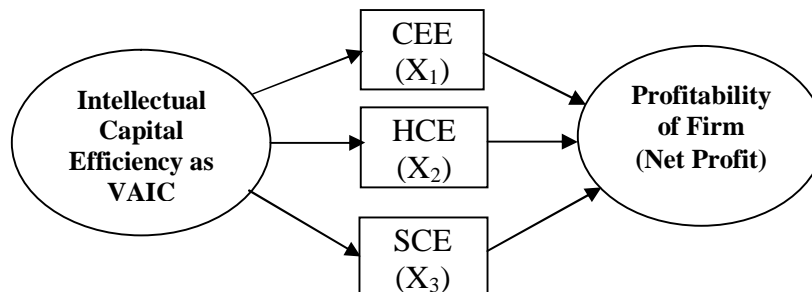
Mavridis (2004), Goh (2005), and Kamath (2007) use VAIC to analyze the performance of Japanese, Malaysian, and Indian banks, respectively, and find significant differences in IC performance. Firer and Williams (2003), using VAIC, indicate that the association between the IC efficiency of value added and profitability, productivity, and market valuation are generally limited and mixed in South Africa. Mavridis (2005) also uses the VAIC and its subordinate concept, the best performance index (BPI), to analyze the performance of the Greek banking sector and focuses on the role of human capital (HC) and physical capital (CA) in value addition.

In recent studies related to the VAIC and the firm's financial performance, Chen et al (2005) examine the relationship between value creation efficiency and market-to-book value ratios, and investigates the impact of IC on the firm's future performance. Shiu (2006) finds a significant positive correlation between the VAIC and profitability and market valuation but a negative correlation with productivity. He uses the ratio of total revenue to total book value of assets as a proxy for productivity. Tan et al (2007) use the VAIC methodology to examine data on 150 listed companies on the Singapore Stock Exchange, and conclude that IC and firm performance are positively related. Tseng and Goo (2005), in an empirical study of Taiwanese manufacturers, visualize a positive relationship between IC and corporate value.

3. Research Framework

The framework of this study is depicted below in Figure 1.

Figure 1: Conceptual Model for IC Efficiency and Firm's Profitability



Proxy Measures for Independent and Dependent Variables

Proxy measures for independent variables identified from the literature review (X_1 , X_2 , X_3) are efficiency determinants of VAIC, i.e., CEE, HCE, and SCE; the dependent variable (Y_i) is net profit.

Y_i = net profit

X_1 = capital employed efficiency (CEE)

X_2 = human capital efficiency (HCE)

X_3 = structural capital efficiency (SCE)

ϵ_i = error term

In this way, the multiple regression model would be:

$$Y_i = \beta_0 + \beta_1(\text{CEE}) + \beta_2(\text{HCE}) + \beta_3(\text{SCE}) + \epsilon_i$$

4. Methodology

Population and Sources of Data

The study is based on financial data of the top 25 companies of Lahore stock exchange (volume wise) from 2002-2006, which was collected through direct contact with firms' head offices, databases, Lahore stock exchange and websites of relevant companies. In the beginning it was thought to include all listed companies of Lahore Stock Exchange. But due to constraints in data availability and coverage of 90% trading of Lahore stock exchange by LSE-25 index companies; the research was reduced to LSE-25. Companies in the case study cover more than five industrial sectors, which increases the representativeness and generalizability of the research outcome within LSE-25 companies.

The VAIC Method

The VAIC used in this study was introduced by Pulic (1998). It provides a new way of measuring value creation efficiency in companies using data available in financial statements. VAIC is designed to effectively evaluate the efficiency in adding value (VA) to

a firm, focusing on value addition in an organization and not on cost control (Pulic 2000). The core concept of the VAIC is that human capital is mainly responsible for a firm's overall performance. The VAIC is based on the following five calculations:

(i) $VA = OUT - IN$

where VA is the value addition from current year resources.

Out = total sales and

In = cost of materials, components, and services.

Alternatively value added can be calculated as:

$$VA = OP + EC + D + A$$

where OP = operating profit, EC = employee cost, D = depreciation, and A = amortization.

(ii) $CEE = VA/CA$

where CEE is the capital employed efficiency of the firm and CA = capital employed (net book value of total assets).

(iii) $HCE = VA/HC$

where HCE is the human capital efficiency of the firm and

HC = total salaries and wages (direct labor + indirect labor + administration, marketing, and selling salaries).

(iv) $SCE = ST/VA$

where SCE is the structural capital efficiency of the firm and ST = VA – HC.

(v) $VAIC = CEE + HCE + SCE$

where VAIC indicates corporate value creation efficiency.

VAIC does not provide the money value of IC. It simply adds the 3 different efficiency factors of IC and calculates an efficiency index that shows how the IC of a firm contributes to value addition. To measure IC efficiency, Pulic (2000) also offers VAIC's subordinate concept that adds human capital and structural efficiency (ICE = HCE + SCE).

5. Survey, Description, Analysis, and Results

The key objective of this study is to examine the role of IC efficiency in firm profitability. Data were collected from five-year audited financial statements of relevant companies. The description of these data aims to better understand the values on the basis of which the IC efficiency of firms and its role in profitability is to be measured. Companies in the sample are not limited to a particular industrial sector, to maximize the extent to which the results can be generalized.

Table-2: Descriptive Statistics of Selected Variables, 2006

Variables	N	Minimum	Maximum	Mean	S.D
Value Added (Rs. In million)	25	-39	70604	12974	17511
Human Capital (Rs. In million)	25	12	14700	2726	3689
Capital Employed (Rs. In million)	25	4248	158840	39420	37734
Structural Capital (Rs. In million)	25	-5097	67384	10248	15516
Cap. Emp.Efficiency	25	-0.0027	0.7450	0.3081	0.2097
Hum. Cap Efficiency	25	-3.2221	21.9286	6.5368	5.1534
Structural. Capital Efficiency	25	-0.9591	1.3104	0.7559	0.3847
Net Profit (Rs. In million)	25	-12763	45970	5228	10733
EPS (Rs.)	25	-6.80	43.90	8.21	10.66
ICE	25	-1.9117	22.8829	7.2927	5.2865
VAIC	25	-1.9144	23.6279	7.6008	5.3994

Table-2 illustrates the mean, minimum, and maximum standard deviation for different dependent and independent variables. The mean of human capital efficiency is 6.5368 with a range from -3.221 to 21.9286. This means that LSE-25 companies produced Rs.6.54 for every 1 rupee spent on human capital. The average VAIC and ICE remained 7.6008 and 7.2927, respectively.

Regression Assumptions

The regression assumptions were checked before running the model. Although time series data were not used during the study, the Durbin Watson (D-W) test was applied to diagnose first-order autocorrelation problem. D-W values calculated ranged from 1.95 to 2.40 using SPSS. Since the D-W is closer to 2 in all situations, this concludes that the regression model is appropriate, and there is no need to use alternative methods (Neter, 1996). The normality assumption

was checked through normal P-P plots extracted through SPSS. The problem of high correlation between independent variables was captured in a correlation matrix, which remained between 0.2 and 0.66 for different variables and was treated as acceptable. Tabachnick and Fidell (1996) explain that 0.90 or greater bivariate correlation between independent variables indicates harmful multicollinearity. Tables 4, 5, and 6 depict a variance inflationary factor (VIF) of less than 1.50 in all cases, indicating no multicollinearity. As Snee (1973) suggests, a VIF of less than 5 eliminates the need to search for alternatives to regression. Variances at each level of independent variables were found homogeneous indicating no heteroscedasticity.

Table-3: Multiple Regression Results for the Year 2006

$Y_{NP} = \beta_0 + \beta_1(\text{CEE}) + \beta_2(\text{HCE}) + \beta_3(\text{SCE}) + \epsilon_i$			
	Beta	St. Error	VIF
Intercept	-9621376046	3956213351	
CEE	26723357490	9008583805	1.379
HCE	452510890	377997996	1.467
SCE	4838810549	4406208160	1.111
$R^2 = 0.529$		Durbin-Watson=1.949	

Table-4: Multiple Regression Results for the Year 2005

$Y_{NP} = \beta_0 + \beta_1(\text{CEE}) + \beta_2(\text{HCE}) + \beta_3(\text{SCE}) + \epsilon_i$			
	Beta	St. Error	VIF
Intercept	-8156676513	3910926583	
CEE	27450441501	6637326889	1.1646
HCE	335317542	277332463	1.2847
SCE	3287077812	4500778880	1.1118
$R^2 = 0.573$		Durbin-Watson = 2.123	

Table-5: Multiple Regression Results for the Year 2004

$$Y_{NP} = \beta_0 + \beta_1(\text{CEE}) + \beta_2(\text{HCE}) + \beta_3(\text{SCE}) + \epsilon_i$$

	Beta	St. Error	VIF
Intercept	-2452369741	2409412022	
CEE	22814560265	7089702847	1.2621
HCE	-39248034	326151644	1.2818
SCE	-152358381	624964195	1.1320
$R^2 = 0.368$		Durbin-Watson = 2.401	

Table-6: Multiple Regression Results for the Year 2003

$$Y_{NP} = \beta_0 + \beta_1(\text{CEE}) + \beta_2(\text{HCE}) + \beta_3(\text{SCE}) + \epsilon_i$$

	Beta	St. Error	VIF
Intercept	-2812040185	2940234527	
CEE	17004468185	5296773588	1.201
HCE	798554634	340739252	1.330
SCE	-3345388214	3769097421	1.118
$R^2 = 0.555$		Durbin-Watson = 2.289	

Table-7: Multiple Regression Results for the Year 2002

$$Y_{NP} = \beta_0 + \beta_1(\text{CEE}) + \beta_2(\text{HCE}) + \beta_3(\text{SCE}) + \epsilon_i$$

	Beta	St. Error	VIF
Intercept	4101291808	3106846846	
CEE	4849441749	2972255589	1.046
HCE	679113516	325066500	1.092
SCE	-10527434228	3691103901	1.068
$R^2 = 0.424$		Durbin-Watson = 2.064	

Tables-3 to 7 present the regression model summaries run for 2006 to 2002. A high coefficient of determination (R^2) in all 5 years shows the strengths of IC in predicting the dependent variable, i.e., the profitability of a firm. The explanatory power of the regression equation over the 5-year period was 52.9%, 57.3%, 36.8%, 55.5%, and 42.4%, respectively. All three components of the VAIC show positive directional signs in all the years except HCE in 2004 and SCE in 2004, 2003, and 2002. These results show a higher R^2 than the study done by Firer and William (2003) who found an explanatory power of 4.8%. Tan et al (2007) found weaker results through multiple regression models with an R^2 8.7% and 12.2% only. The tables also show that CEE has a significantly positive effect on the net profitability of a firm (Significant) in all the years. The overall results support the argument that all three components of VAIC have a strong impact on the net profit of a firm, suggesting that a firm with greater IC efficiency would fare better in terms of profitability.

6. Usefulness of the Study

As a pioneering attempt to analyze the performance of LSE-25 from the perspective of IC, this paper is a good source of reference for future research in the Pakistani corporate sector. The study is based on strong theoretical foundations and research-proven methodology. The data utilized in this study were also prepared by qualified accountants and audited by statutory auditors, thus increasing reliability. Additionally, this study contributes to the existing literature in the following ways:

1. It provides the evidence on the role of IC in profitability of a company using five-year data for different industrial sectors of the LSE. Different components of VAIC show a significant explanatory power for the firm's traditional financial performance. The findings of the study highlight the importance of the role of IC in gaining a competitive advantage in emerging economies.
2. More than 90% of investors at the LSE and fund and portfolio managers will benefit from the idea of IC modeling as a better measure of evaluating the firm than the traditional approach of net profitability while developing a portfolio. They can observe the impact of IC efficiency not only on annual dividends but also on capital gains. Flostrand (2006), while conducting research on 250 sell-side analysts selected from S&P-500 companies, finds that analysts use IC indicators frequently in their decision making.

3. The study proves that VAIC can be used by regulatory authorities to identify the weaknesses and strengths of different industries to help determine which industrial sectors should be subsidized.

Limitations of the Study

Due to the non availability of non listed and proprietary sector data, this research is limited to LSE-25 index companies. The results of the study cannot, therefore, be generalized to apply to the whole stock market or the non listed sector. Human and structural capital efficiency is not comparable among different sectors within the LSE-25 since different industries are composed of different IC-related factors.

Future Research

Future study could include extending the IC approach to all the listed companies in Pakistan while focusing on the impact of IC efficiency on future financial performance and total capitalization of companies. Researchers could also concentrate on studying the impact of IC in the intellectual-intensive pharmaceutical sector.

7. Concluding Remarks

The study was conducted to examine the relationship between IC and a firm's profitability through empirical research, which has been concluded successfully. The contribution of this research is important both for academic researchers as well as business professionals. IC literature is beneficial in deciding the potential role of IC efficiency in a firm's performance: business professionals benefit by understanding the importance of allocating their precious resources to support IC and ultimately the firm's financial performance. Keeping in view the significant role of IC in financial performance, the study emphasizes the need for guidelines for measuring and disclosing IC in financial reports. As a supervisory body for the corporate sector, the Securities and Exchange Commission of Pakistan and its technical advisors, the Institute of Chartered Accountants of Pakistan and the Institute of Cost and Management Accountants of Pakistan, are urged to take the initiative in this regard. Moreover, as Pakistan opens its stock markets to foreign investors who need financial and nonfinancial information to assist in their decision making, reporting IC becomes all the more important. In a global environment, if information related to IC, health, safety, environment, and corporate social responsibility issues is disclosed in

firms' annual reports, it could enhance their value in the eyes of international investors. Managers are advised that good structural capital should convert human efficiencies into internal organizational structure, administrative culture, and corporate knowledge. This study is one of the first empirical tests of association between IC and a firm's financial performance in Pakistan, thus proving a good source for IC researchers in the future.

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Measuring Volatility of Inflation in Pakistan

Nadia Saleem*

Abstract

The available evidence in Pakistan suggests that inflation is a monetary phenomena. This paper examines the relationship between the determinants of inflation and its volatility by using monthly data for 1990:M1-2007:M5. The determinants of inflation are estimated by a VAR analysis, which shows that inflation, the interest rate and money supply move together. A VAR model assumes constant error variance. We relaxed this assumption by employing an ARCH/GARCH model and conclude that inflation is volatile in nature. For measuring the qualitative nature of the inflationary process we used an EGARCH model. It confirms that the time effect model is significant. It also suggests that in the first four months of the calendar year, the inflationary shock is negative and it can, therefore, hamper growth.

JEL Classification: C01, E31, E51.

Keywords: Inflation, Volatility, Pakistan, Money Supply, Interest Rate.

Introduction

This paper sets out to explain that inflation emerges from permanent factors (measured) and transitory factors (unmeasured and temporary). Measured inflation is mainly due to monetary variables which the central bank can control to a certain extent but the transitory nature of inflation is unmeasured and a source of uncertainty. This transitory part consists of shocks like oil price hikes. These shocks are beyond the control of the central bank. This gives rise to uncertainty, which is the source of volatility and thus leads to less credible monetary policy. Inflation has a shoe leather cost, which affects resource allocation: it distorts market incentives and reduces efficiency: it can also destabilize governments for failing to control prices. Price hikes are one of the causative factors of changes in central bank policies. Central banks are no more able to give priority to any other objective over price stability. Therefore, there is a need to understand the

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dynamic nature of inflation in the first instance and then the role of volatility as it gives misleading signals to policy makers and economic agents.

Money is responsible for inflation but disagreement exists among economists on the role of money and its impact on the economy. Classical economists believed in the predominance of the transaction motive to hold money and the central bank exogenously determining money supply which has no impact on the real side of the economy. Money is thus considered no more than a veil and what has come to be known as the classical dichotomy prevailed. Prices changed but only with the change in money stock. No relationship exists between money supply and interest rates which are determined in the loanable funds market (saving and investment). Keynesians refute the dichotomy and believe in a negative relationship between money supply and the interest rate due to the indirect effect of unemployment. They emphasize the liquidity effect. Increased money supply affects the demand for liquidity and hence generates inflation and decreases the interest rate. According to them, increased government expenditure and lower taxes are responsible for inflation. Further, they dismiss the idea that shocks can generate inflation in the long run. The Monetarists believe that an increase in money supply shifts the aggregate demand, which increases output and decreases the unemployment rate below the natural rate of unemployment and increases the wage rate. The increased wage rate results in a decrease in demand for labor, which shifts the aggregate supply curve leftward. If this process continues in subsequent years, the economy will experience higher and higher inflation. In this way, Monetarists not only accept the liquidity effect but also the price effect and the income effect of demand for money. The role of the interest rate is no more dependent on money supply but on the demand for money. When the central bank decreases the money supply, it will result in an increase in the interest rate in the first instance. This will lead to a decrease in money demand in response and what happens to the interest rate in the end is indeterminate and depends on the income effect, wealth effect, inflation rate, and expectations (Mishkin, 1989).

According to Friedman (1977), upward movements in the price level are a monetary phenomenon only if this is a sustained process. Keynes and the Monetarists are agreed on the proposition that money alone is to blame for inflation and the interest rate appears as an integrating factor between the financial side and the real side of the

economy. They emphasized the wealth effect, income effect and price effect.

Due to the instability and unpredictability of money demand, central bankers are using the interest rate to cut down inflationary expectations and the current inflation rate. The first time that inflation was targeted explicitly was towards the end of the 1980s by New Zealand. In this policy, an independent central bank uses the interest rate instead of money demand as an anchor for an exclusive focus on inflation. A direct relationship between the rate of inflation and the rate of interest enables investors to forecast the future inflation rate in case inflation deviates from the target.

This paper is divided as follows. In the next section, we review the literature related to the dynamics of inflation and empirical findings on the subject. The third section will provide the theoretical framework on the subject. Empirical results are in the fourth section. The last section presents conclusions drawn from the research.

2. Literature Review

In Mishkin and Posen (1997), price stability is stated as the primary goal of monetary policy. The authors make this conclusion by considering costs of inflation. An obvious cost of inflation is that people use non-interest bearing money because inflation could offset their interest income.

In the economic literature, views differ widely on the causes of inflation. The contemporary debate on inflation started with the monetarists' belief that money supply is the source of inflation, in contrast to the Keynesians' emphasis on structural factors. Post-Keynesians agreed with the findings of the monetarists but maintained that increased money supply was a necessary condition of inflation but not a cause of it. According to Zimmermann (2003), New Keynesians believe that the "economic shocks" caused by "nominal rigidities" and prevalence of "involuntary unemployment" are the reasons for inflation in the economy. They support rule-based policies for controlling inflation and the efficacy of monetary policy.

Friedman (1977) argues that inflation uncertainty is costly since it distorts relative prices and increases risk in nominal contracts. As inflation becomes highly unpredictable, investment and growth slow down. He

further postulates that output growth is adversely affected by the volatility of inflation because increasing volatility makes it difficult for consumers to determine relative prices accurately. In addition, inflation volatility makes long term contracts more costly and thus less attractive. In either case, economic efficiency is reduced, subsequently retarding economic growth.

Engle (2004) constructed ARCH models to answer the unpredictability of inflation: “the original idea was to find a model that could assess the validity of the conjecture of Friedman (1977) that the unpredictability of inflation was a primary cause of business cycles. Uncertainty due to this unpredictability would affect the investors’ behavior. Pursuing this idea required a model in which this uncertainty could change over time”.

Neyapti (2000) shows that inflation significantly raised uncertainty. Evidence in Nas and Perry (2000) supports this finding, while the evidence on the effect of inflation uncertainty on the level of inflation is mixed and depends on the time period analyzed. They used the EGARCH technique for modeling inflation uncertainty.

GARCH models not only allow the incorporation of the effects of the conditional mean into the system but also “accommodate the effects of the inflation shock on inflation volatility, and, in turn, the effects of inflation volatility on economic activity,” (Elder, 2003).

To recapitulate, inflation emerges from monetary sources and the presence of nominal rigidities, and an unclear policy stance not only generates inflationary expectations but also triggers uncertainty. Not only is there a need to control the inflation rate due to its impact on economic growth but also to decrease volatility. Inflation increases volatility and uncertainty. This volatility again generates inflation due to wrong decision making by individuals. There is thus a two-way link between inflation and volatility.

In the Pakistani context, most authors conclude that money is the most significant cause of inflation in Pakistan. Our judgment that inflation in Pakistan is a monetary phenomena, originates from various empirical studies. Qayyum (2007) tested the monetarist proposition and presented findings that 90 percent of the variation in inflation was due to easy monetary policy adopted by the State Bank of Pakistan. Madhavi and Schimmelpfennig (2005) found that broad money growth and private

sector credit growth helped explain inflation in Pakistan. Mubarik (2005), Jones and Khilji (1988), Khan and Siddiqui (1990), Bengali, *et. al.* (1997), and Hussain and Tariq (1997) all tried to find long run determinates of inflation in Pakistan. They emphasized that inflation is a monetary phenomenon²⁶.

This type of conclusion leads the discussion towards the role of the State Bank of Pakistan in controlling inflation and the influence of money in the real sector. These authors measured the determinants of inflation, which are either monetary variables or structural variables, but no study measured the impact of unobservable shocks and volatility on the inflation rate. This study aims to explore the dynamic nature of inflation and applies the VAR methodology to finding the relationship between the Consumer Price Index (CPI), broad money supply output and the lending rate.

3. Model, Data and Econometric Methodology

3.1. Model Specification

We use the model given by Soderstorm (1999), who criticized Svensson (1997) for ignoring the explicit interest rate equation in the model and showed that this omission results into a more aggressive policy prescription. According to the author, the central bank cannot afford the aggressive policy for controlling inflation because of the inverse relationship between interest rate and investment. We modified their model by introducing the broad money supply equation along with CPI, Y (output), and LR (loan rate). This explicit money supply equation in the model will enable us to comment on the inflationary process and reduce volatility because the State Bank is using monetary aggregates for controlling inflation. We used an unstructured generalized VAR model for determining the inflationary process in Pakistan. Once we are able to estimate the nature of the inflation process in Pakistan we will further estimate volatility in the inflation rate because it generates uncertainty. In a high inflationary environment, individuals respond differently than in normal circumstances. There is no definitive judgment available as to why in certain time periods increases in money supply generate more negative

²⁶ There are some studies which conclude that inflation is structural in nature. Khan and Qasim (1996) find food inflation to be driven by money supply, value-added in manufacturing, and the wheat support price. Khalid (2005) suggested that “imported inflation, seigniorage and openness cause inflation in Pakistan.”

effects as compared to normal time periods. The answer may lie in expectations or underdeveloped, less integrated markets. This riddle requires deeper investigation of inflation and money supply dynamics. It is important because several studies have shown that volatility increases uncertainty which badly affects macroeconomic stability.

Vector auto regressive models assume constant error variance, providing dubious results. What happens to the results if inflation is volatile in nature or if inflationary shocks are GARCH in nature? The present paper offers insights on inflation in Pakistan and measures the sources of volatility by using ARCH/GARCH and EGARCH techniques.

3.1.1. Vector Auto Regressive Model

We use vector auto regressions and impulse response functions to show the relationship between broad money supply (M2), the consumer price index (CPI) output (IP) and the call money rate (CM). It will enable us to analyze the impact of money supply on inflation and the call money rate. We will further explore how a shock in one of the variables influences the time behavior of other variables. It will also allow us to study the role of the interest rate as a nominal target in Pakistan. (See Appendix 1 for details of the VAR and ARCH/ GARCH models.)

3.1.2. Exponential GARCH Model

Engle (1982) and Bollerslev (1986) developed the ARCH/GARCH models, which allow incorporation of the time varying nature of the variables. Furthermore, volatility in inflation is negatively related to economic growth. Nelson (1991) proposes an extended version of GARCH type models: the Exponential Generalized Auto Regressive Conditional Heteroscedastic (EGARCH). The EGARCH method has several advantages compared to both ARCH and GARCH methods to model inflation uncertainty for the following reasons. First, it allows for asymmetry in the responsiveness of inflation uncertainty to the sign of shocks to inflation. Secondly, unlike the GARCH specification, the EGARCH model, specified in logarithms, does not impose non-negativity constraints on parameters. Finally, modeling inflation and its uncertainty in logarithms hampers the effects of outliers on the estimation results. The EGARCH model has been commonly used to examine inflation rates, interest rates, exchange rates and to analyze stock returns (Brunner and

Simon, 1996; Tse and Booth, 1996). Following Berument and Malatyali (2001) we model inflation by using lagged inflation and monthly seasonal dummies to account for seasonality:

$$\Pi_t = \sum_{i=1}^n \alpha_i \Pi_{t-i} + \sum_{i=1}^{12} \delta_i m_{it} + \lambda D_{12} + \varepsilon_t \quad 1a$$

In Eq (1a) Π_t represents inflation and m_{it} stands for the monthly dummies ($i=1,2,\dots,12$) that account for monthly seasonal effects;

$$\text{Log}h_t^2 = \beta_0 + \beta_1 \frac{\varepsilon_{t-1}}{h_{t-1}} + \beta_2 \frac{\varepsilon_{t-1}}{h_{t-1}} + \beta_3 \text{Log}h_{t-1}^2 + \lambda_1 D_{12} \quad 1b$$

Equation 1b is the EGARCH representation of the conditional variance of inflation at time t . ε_t follows the usual white noise assumptions of zero mean and constant variance. $\varepsilon_{t-1}/h_{t-1}$ follow the standard normal distribution. $\varepsilon_{t-1}/h_{t-1}$ and the log of the lagged value of the conditional variance (h_{t-1}^2) are used to explain the behavior of the conditional variance. β_2 represents the impact of good news or bad news. For good news it is greater than one and for bad news it is less than zero.

3.2. Data Sources and Methodology

The aim of the analysis is to build a statistical model that would link such macroeconomic variables such as the CPI to the growth rate in broad money supply (M2) and the call money rate (as a proxy for the interest rate). For ensuring a large sample size and for modeling sufficient variability, we used monthly data series of these aggregates from 1990:01 to 2007:07. The monthly data series (of 1990 M1-2007 M5) is obtained from International Financial Statistics (IFS) (2007) and from the web site www.statpak.gov.pk/depts/index.htm, Federal Bureau of Statistics, Government of Pakistan. Annual data series (1970-2007) is obtained from the World Development Indicators (2007).

3.2.1. Variables and Definitions

Broad Money Supply (M2): The broad money (M2) consists of M1, time deposits and resident foreign currency deposits with the scheduled banks. This implies that M2 takes into account not only those financial assets which can directly be used as a medium of exchange but are also close substitutes of liquid assets (State Bank of Pakistan, 2008).

Consumer Price Index (CPI): The CPI is the most relevant tool of measuring inflation in consumer items. The Federal Bureau of Statistics regularly collects price statistics resulting in the monthly release of a Consumer Price Index (Federal Bureau of Statistics, 2008).

Call Money Rate (CM): Call money generally refers to secured or unsecured 'at-call' loans made by banks to money market dealers. According to the State Bank of Pakistan, interbank clean (without collateral) lending/borrowing rates are referred to as Call Money Rates (State Bank of Pakistan, 2008).

Industrial Product (IP): Large scale manufacturing index is used as proxy for measuring output (International Financial Statistics, 2007).

4. Analysis and Results

4.1. Inflation Dynamics: Overview of Pakistan's Economy

Inflation in Pakistan has not received serious attention from government policy makers, although price stability is one of the basic policy objectives of the State Bank of Pakistan. The inflation rate had been historically low. A mere 3.3 percent in the 1960s, it rose to 11.9 percent on average in the 1970s due to oil shocks which destabilized all economies, and fell again to an average of only 7.5 percent in the 1980s. Since the 1990s inflation became a matter of some concern. The recent high inflation rate has attracted the attention of a number of economists in Pakistan. Rapid increases in world oil and commodity prices, wheat shortages, mounting fiscal deficits and increased bank borrowing are considered the main reasons for inflation in the economy.

The GDP growth rate remained below 5 percent until the late 1970s during which inflation remained in mostly double digits. On average it could be suggested that the growth performance was dismal in the years of double digit inflation rate in Pakistan. The lowest observed rate of inflation in 1986 was preceded by a very high growth rate in 1985. In the 1990s the inflation rate was in double digits and the economy experienced poor growth. It may, therefore, be suggested that high inflation is one of the causative factors for low growth rate in the economy but we cannot generalize it.

For observing trends in the Consumer Price Index (CPI), broad money supply (M2) Gross Domestic Product (GDP) and Market Exchange

Rate(MXR) we plot the log series against time. The line graphs show an upward trend during the period of 1970-2007. An important conclusion which can be drawn is that inflation, money supply, nominal exchange rate and output series are positively related (Appendix 2).

Table-1: Descriptive Statistics for the Growth Rate of Broad Money Supply, Inflation Rate, Depreciation Rate and Call Money Rate (1990:M1-2007:M5)

Statistics	Call Money Rate	Depreciation Rate	Inflation Rate	Growth Rate in Broad Money Supply	Annual GDP Growth Rate
Mean	8.49	0.58	7.24	4.92	5.37
Maximum	18.37	8.48	20.35	905.79	11.4
Minimum	0.74	-2.38	0.06	-90.04	0.468
Skewness	-0.03	2.68	0.27	14.61	0.056
Kurtosis	2.42	11.30	2.55	217.23	2.87
Std. Dev.	3.86	1.47	3.84	60.79	2.49

Table-1 shows that the inflation rate, call money rate and growth rate in money supply are highly volatile, having very high standard deviations compared to GDP. In a managed floating exchange rate regime, the role of monetary policy is limited as it is subservient to the import transmitting countries' exchange rate. So we ignored the exchange rate in the discussion. According to the information in Table-1, CPI and the growth rate in broad money supply are highly volatile series.

4.2. Empirical Results of Unrestricted VAR

For estimating the unrestricted Vector Auto Regressive (VAR) model, the order of integration of all the endogenous variables is needed. In this paper we apply tests such as Augmented Dickey-Fuller (ADF) on the level data of Consumer Price Index (CPI), broad money supply (M2), output (Y) and lending rate (LR). All the variables are integrated with order one, $d(1)$. Max lag length is 2, determined on the basis of the Schwarz Information Criterion. As it is monetary data, we prefer short lag lengths. As the data used in VAR is non-stationary, we use a first difference VAR model. It explains the short run dynamic relationship between the data. We started with the theoretical debate that inflation is a monetary phenomenon and it can be controlled through nominal anchors.

The results in Table-2 show that CPI is positively related to the call money rate for both lags but is insignificant. CPI is positively associated

with previous lags of CPI and it is significant. CPI is positively related to output at the first lag and negatively related to output at the second lag which makes the case that inflation hampers growth but again it is insignificant at both lags. CPI is positively related to the broad money supply at both lags which confirms that inflation is a monetary phenomena; an increase in money supply results in an increase in the inflation rate but the results are again insignificant.

Table-2: VAR Regression Results (1990: M1-2007:M5)

	<i>CPI</i>	<i>IP</i>	<i>M2</i>	<i>CM</i>
CM Lag 1	0.03193	-0.37567	0.036527	0.53689
t ratios	[0.77506]*	[-1.43372]	[0.92027]*	[7.81212]
CM Lag 2	0.023324	0.381535	0.11527	0.184558
t ratios	[0.56553]*	[1.45439]	[2.90074]	[2.68229]
CPI Lag 1	0.544396	0.322265	0.03706	0.03162
t ratios	[8.51346]	[0.79230]	[0.60147]*	[0.29640]*
CPI Lag 2	0.445756	-0.07228	0.024679	-0.04005
t ratios	[6.98358]	[-0.17803]	[0.40127]*	[-0.37610]*
IP Lag 1	0.007317	0.848674	-5.05E-05	0.047227
t ratios	[0.68223]*	[12.4401]	[-0.00489]*	[2.63935]
IP Lag 2	-0.002418	-0.036	0.003396	-0.04758
t ratios	[-0.22696]*	[-0.53132]	[0.33079]*	[-2.67720]
M2 Lag 1	0.00919	2.17436	-0.12586	-0.12525
t ratios	[0.13046]*	[4.85116]	[-1.85371]	[-1.06542]*
M2 Lag 2	0.05583	1.796752	-0.17805	0.072238
t ratios	[0.76003]*	[3.84551]	[-2.51566]	[0.58947]
C	0.688695	-5.8748	3.024172	3.105588
t ratios	[1.17960]	[-1.58193]	[5.37578]	[3.18834]
Adj. R-squared	0.996456	0.924929	0.059064	0.46633
F-statistic	7372.373	331.3104	35309.76	23.43933

* Shows Insignificant Results

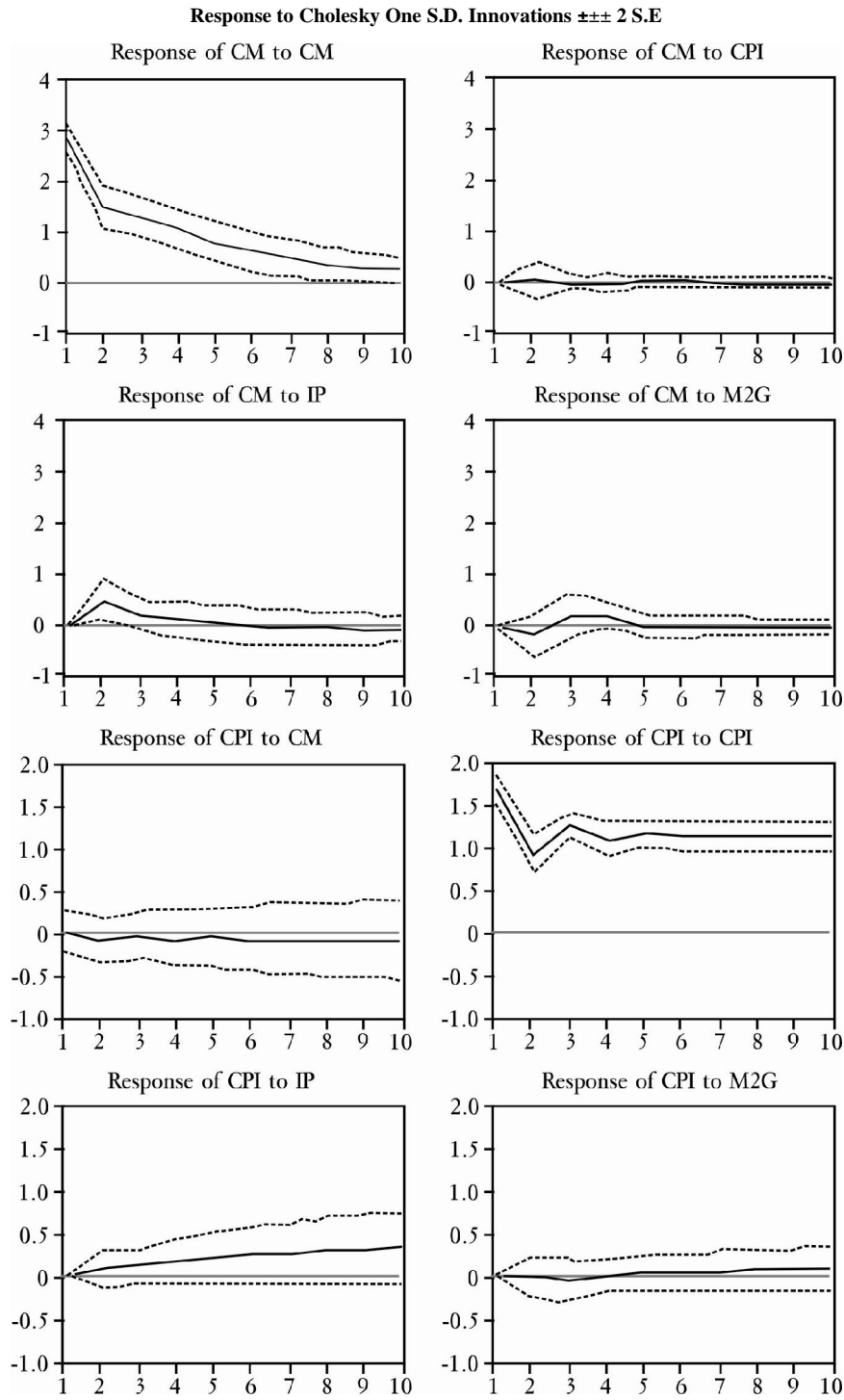
Money supply is positively related to the call money rate (CM) at both lags. It is insignificant at the first lag and insignificant at the second lag. This fact sheds light that in Pakistan the income and price effect is stronger than the liquidity effect. This makes the case that money supply and the interest rate are moving in the same direction. When money supply increases, the quantity demanded for money increases in the first instance and results in a lower interest rate. If people expect more inflation and demand for money increases rapidly then the interest rate will also shoot up. The result that money supply and the interest rate are moving in the same direction suggests that there is strong demand for money (liquidity effect) in the economy. In this scenario we can infer that the inflation rate, interest rate and growth in money supply move together in Pakistan. The results of the VAR are insignificant, thus not reliable, and call for the further investigation of the inflation rate.

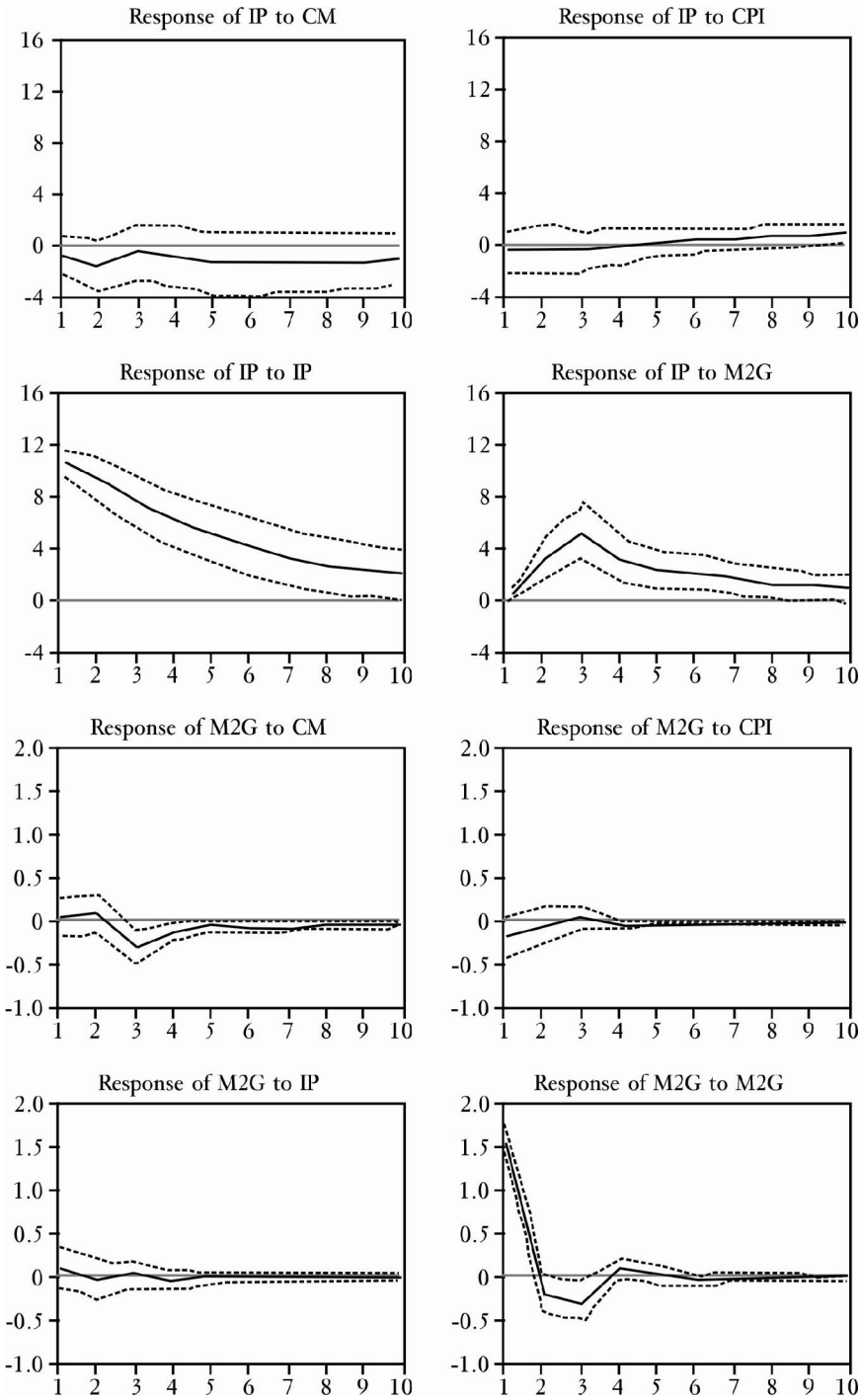
4.2.1. Impulse Response Function

An impulse response function traces the effect of a one-time shock to one of the variables on current and future values of the endogenous variables. It is the effect of an outside shock to a variable (Hamilton, 1994). If the value of impulse response function is positive and less than one, it means that the response dies down monotonically, approaching zero.

In figure 1, we present the impulse response graph. When a shock is generated from the call money rate to call money rate, it started with the value greater than zero but its response dies out to zero from the above. The response of call money to the CPI is fluctuating between positive and negative values but it is a convergent case and highly significant as it dies out to zero. The response of call money to broad money supply is also convergent and stable. The response of the CPI to a call money rate shock monotonically dies out and approaches zero, resulting in a stationary series. The response of CPI to CPI is divergent and it never dies out. This means that the CPI has an explosive impact on current CPI. A shock in form of broad money supply has a convergent affect on all the variables as the series dies out to zero, making it significant and stable.

Figure 1: Impulse Response Function





4.3. Measuring Volatility in Inflation Rate

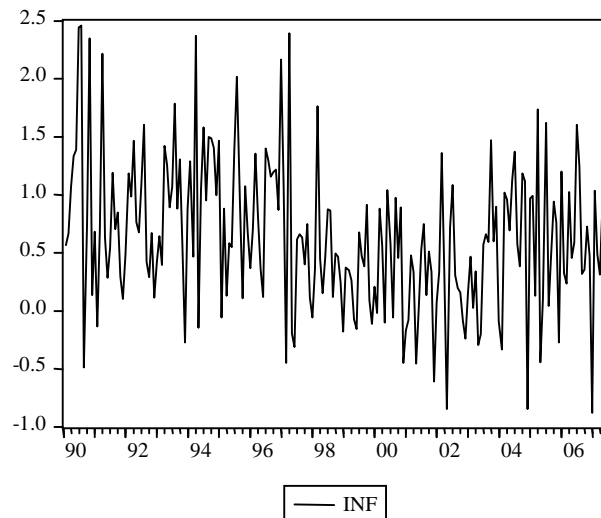
VAR analysis helped us in measuring the permanent nature of inflation relations. Now we concentrate on the transitory nature of inflation volatility by employing a GARCH model so that we can relax the assumption of constant variance.

For modeling inflation rate we conduct the Augmented Dickey Fuller unit root test. It confirms that CPI data is not stationary. Thus we analyze the first difference of the series which is stationary. We use the first difference of the seasonally unadjusted CPI over the period 1990:1 to 2007:7. The first difference can damage the actual relationship but it can explain the short run relationship (Appendix -3).

Pre- Estimation of ARCH/GARCH Effect:

We compute the inflation rate from a seasonally unadjusted series of CPI and plot the series. As can be seen in Figure 2, it shows high volatility.

Figure-2: Monthly Inflation Rate of Pakistan



After conducting the unit root test and transforming a non-stationary series into a stationary one, we plotted the Auto Correlation Function (ACF) and Partial Auto Correlation Function of the series. From the correlogram we determined the order of AR model which showed maximum significance at 3 lags. This means that we have an Auto Regressive

Integrated model ARI (3,1). CPI has 3 months lag memory. The results obtained from ARI (3,1) demonstrated that there is a feedback of inflation after 3 months which is significant and stable. The estimated coefficient of the lagged variable which measures inflation uncertainty is positive and statistically significant (Appendix-4).

$$D(\text{cpi}) = 0.3686 + 0.2919 d(\text{cpi}(-3))$$

$$(7.29) \quad (4.32)$$

$$\text{P-values} \quad (0.00) \quad (0.00)$$

After estimating the univariate CPI series, we checked it for ARCH effects. There is significant serial correlation. It is evident that we can apply the ARCH technique for modeling inflation in Pakistan. We conducted the Engle ARCH test. This test also provided significant evidence in support of GARCH effects (i.e., heteroscedasticity).

ARCH LM Test

In order to confirm the ARCH effect in the CPI series we apply the ARCH LM test. It is significant. The ARCH-LM statistic cannot reject the null hypothesis that there is no ARCH effect for the standardized residuals up to the 36th lag. (Appendix-5)

4.3.1. Estimation of Variance Equation: (GARCH) (1,1)

There is a positively significant relationship between the residuals which suggests increased volatility in the unanticipated rate of inflation.

$$h_t = -0.0014 + 0.00157 \epsilon_t^2 + 0.9122 h_{t-1}$$

$$(0.0012) \quad (0.0009) \quad (0.0084)$$

$$\text{P-Values} \quad (0.26) \quad (0.09) \quad (0.00)$$

Post Estimation Analysis

The same Ljung-Box-Pierce Q-Test applies to the square residuals. It confirms there is no serial correlation and that there is no GARCH effect left.

QQ Plot

The QQ plot indicates that it is primarily large negative shocks that are driving the departure from normality. The plot shows that there are negative shocks which are causing the inflation rate to drift away from normality (Appendix -6).

4.4. EGARCH Model

The presence of the negative shocks leads us to estimate the same model with time dummies. The parameters of the EGARCH model are measured on the basis of monthly time dummies. This model captures the impact of seasonal dummies and asymmetric information on the CPI as well as the impact of money supply, call money rate and industrial output. Therefore, we estimated a VAR model of the CPI. Given below is the mean equation of the model.

$$\text{CPI} = 0.059 + 0.0028\text{CM}(-1) + 0.0042\text{CM}(-2) + 0.628\text{CPI}(-1) + 0.383\text{CPI}(-2) - 0.0059\text{IP}(-1) + 0.0046\text{IP}(-2) + 0.0028\text{M2G}(-1) + 0.0177\text{M2G}(-2)$$

(Mean Equation)

$$\text{LOG}(h_t) = -0.347 + 0.638 |e_{t-1}|/h_{t-1}^2 - 0.289 e_{t-1}/h_{t-1}^2 + 0.974 \text{Log } h_{t-1}^2$$

(Variance Equation)

This equation is significant and the value of 0.974 confirms the presence of EGARCH on the data. The coefficient $-0.289 < 0$ shows the negative effect of the inflation. It means bad news generates more volatility as compared to good news. The impact of negative and positive shocks are asymmetric (Appendix-7).

Table-3: Fixed Effect Model

Monthly Dummies	Fixed Effect	Monthly Dummies	Fixed Effect
1	-0.707	7	0.001599
2	-0.01497	8	0.002192
3	-0.00881	9	0.003669
4	-0.00312	10	0.010343
5	0.001232	11	0.01302
6	0.001317	12	0.015309

On the basis of the asymmetric effect of inflation we measured the time varying affect of the model by incorporating time dummies. The time dummies are significant and show that inflation in the first 4 months of the year can generate a negative shock to the model and that feedback exists for unanticipated inflation. Positive innovations show a decline of volatility.

Conclusion

The main conclusion of the paper is that inflation is volatile in nature and this generates uncertainty in the economy. The significance of this feature of inflation is that uncertainty can affect growth adversely.

The analysis in this paper finds that inflation volatility is significantly and positively related to the level of inflation, which can generate uncertainty in the economy. Money supply is also volatile in nature.

Inflation volatility, as measured by the EGARCH model, robustly and significantly creates unanticipated negative shocks in the first four months of the calendar year. These negative shocks on the one hand can hamper growth and on the other hand explain that a time effect (seasonal effect) also exists in the case of inflation in Pakistan. If a shock in the first four months emerges it may be due to increased oil consumption (energy use increases in winter) as compared to the summer season. This is the time period when there may be food shortages, which is a causative factor of inflation. This phenomenon calls for further in-depth investigation.

Money supply is also found to be volatile in nature. There is significant evidence that it can generate shocks in inflation. An important feature to note is that there exists a feedback effect from broad money supply to inflation. VAR results show that inflation, money supply and the interest rate move into same direction.

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Appendix-1

Vector Auto Regressive Models:

When variables are not exogenously determined, Y_t and X_t are affected by current value and past values of Y_t and X_t simultaneously, where we assume Y_t and X_t are stationary and error terms are uncorrelated. It constituted the first order VAR.

$$\begin{matrix}
 \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} & \begin{bmatrix} CPI_t \\ LR_t \\ M2_t \\ Y_t \end{bmatrix} & = & \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} \\ b_{21} & b_{22} & b_{23} & b_{24} \\ b_{31} & b_{32} & b_{33} & b_{34} \\ b_{41} & b_{42} & b_{43} & b_{44} \end{bmatrix} & \begin{bmatrix} CPI_{t-1} \\ LR_{t-1} \\ M2_{t-1} \\ Y_{t-1} \end{bmatrix} & + & \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \end{bmatrix} \\
 A & Z_t & & B & Z_{t-1} & & u_t
 \end{matrix}$$

Matrix A in this equation shows contemporaneous response or immediate response of variables to changes in other variables. The relationship can be represented as follows:

$$AZ_t = BZ_{t-1} + U_t$$

To run regressions one needs dependent variable on the left-hand side and independent variables on the right hand side. After rearranging:

$$Z_t = A^{-1}BZ_{t-1} + A^{-1}U_t$$

Now denote $A^{-1}B$ by C and $A^{-1}U_t$ by W_t to obtain the following regression:

$$Z_t = CZ_{t-1} + W_t$$

ARCH/GARCH Models

An autoregressive conditional heteroskedasticity (ARCH, Engle (1982)) model considers the variance of the current error term to be a function of the variances of the previous time period's error terms. ARCH relates the error variance to the square of a previous period's error.

He measured residuals as

$$\varepsilon_t = y_t - \mu_t(yt)$$

Where y_t is an observable random variable. Engle assumed that ε_t can be decomposed as follows:

$$\varepsilon_t = \chi_t h_t^{1/2}$$

Where $\{\chi_t\}$ is a sequence of independent, identically distributed (iid) random variables with zero mean and unit variance. ARCH modeling can be applied to a normal distribution or a leptokurtic distribution. The following conditional variance defines an ARCH model of order q :

$$h_t = \alpha_0 + \sum_{j=1}^q \alpha_j \varepsilon_{t-j}^2$$

The parameter restrictions in the above equation form a necessary and sufficient condition for positivity of the conditional variance.

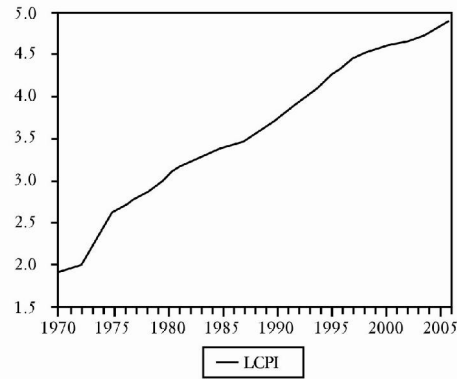
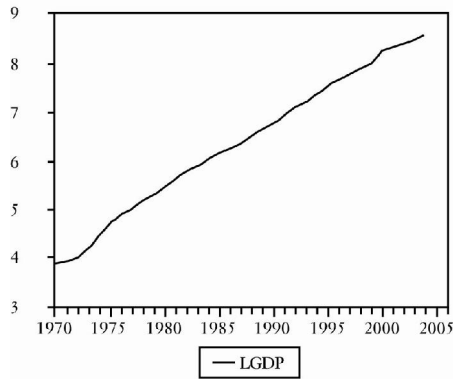
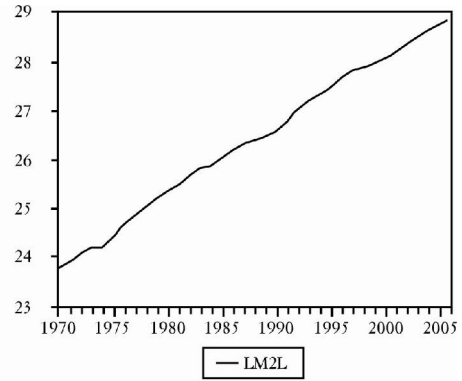
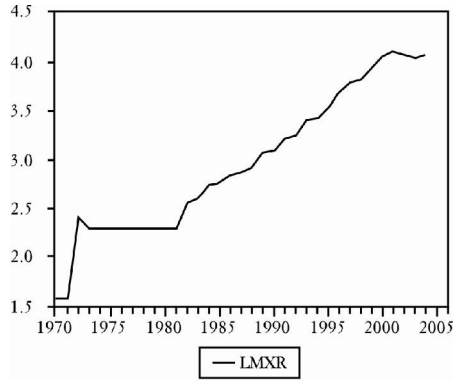
Bollerslev (1986) and Taylor (1986) proposed GARCH model independently of each other. They criticized use of squared residuals in variance equation is an obvious but not necessarily a very good solution for modeling conditional variance if data of higher frequency are available. In their model, the conditional variance is also a linear function of its own lags and has the form

$$h_t = \alpha_0 + \sum_{j=1}^q \alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^p \beta_j h_{t-j}$$

For the ARCH family, the decay rate is too rapid compared to what is typically observed in financial time series, unless the maximum lag q in ARCH variance equation is long. For avoiding this problem Nelson (1991) proposed EGARCH models.

Appendix-2

Trend Analysis of Broad Money Supply, Inflation Rate, Nominal Exchange Rate and GDP (1970-2007) Annual Data.



Appendix-3**Unit Root Test****Null Hypothesis:** CPI has a unit root**Exogenous:** Constant**Lag Length:** 3 (Automatic based on SIC, MAXLAG=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	1.197583	0.9981
Test critical values: 1% level	-3.461938	
5% level	-2.875330	
10% level	-2.574198	

Null Hypothesis: D(CPI) has a unit root**Exogenous:** Constant**Lag Length:** 2 (Automatic based on SIC, MAXLAG=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.265166	0.0000
Test critical values: 1% level	-3.461938	
5% level	-2.875330	
10% level	-2.574198	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: M2G has a unit root**Exogenous:** Constant**Lag Length:** 11 (Automatic based on SIC, MAXLAG=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.852071	0.0530
Test critical values: 1% level	-3.463405	
5% level	-2.875972	

10% level

-2.574541

Null Hypothesis: D(M2G) has a unit root

Exogenous: Constant

Lag Length: 10 (Automatic based on SIC, MAXLAG=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-9.778731	0.0000
Test critical values: 1% level	-3.463405	
5% level	-2.875972	
10% level	-2.574541	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LR has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic based on SIC, MAXLAG=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.541799	0.0078
Test critical values: 1% level	-3.461783	
5% level	-2.875262	
10% level	-2.574161	

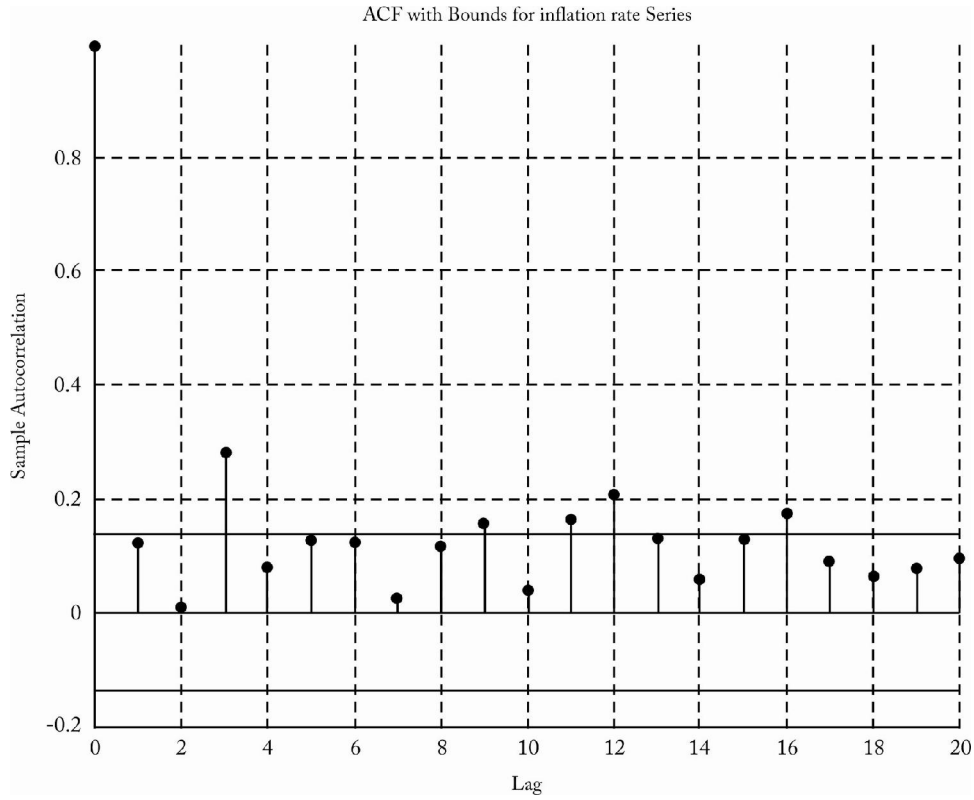
*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LR) has a unit root

Exogenous: Constant

Lag Length: 4 (Automatic based on SIC, MAXLAG=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-10.23082	0.0000
Test critical values: 1% level	-3.462253	
5% level	-2.875468	
10% level	-2.574271	

Appendix-4**Auto Correlation Function****Estimating Mean Equation of ARI (3, 1)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.368649	0.050560	7.291354	0.0000
D(CPI(-3))	0.291906	0.067622	4.316703	0.0000
R-squared	0.883323	Mean dependent var		0.516280
Adjusted R-squared	0.778852	S.D. dependent var		0.558219
S.E. of regression	0.535758	Akaike info criterion		1.599348
Sum squared resid	58.84261	Schwarz criterion		1.631548
Log likelihood	-163.5325	F-statistic		18.63393
Durbin-Watson stat	1.914153	Prob (F-statistic)		0.000025

Appendix-5**Pre Estimation of ARCH Model***Ljung-Box-Pierce Q-Test*

H	P-Value	Stat	C-Value
1.0000	0.0001	37.0742	18.3070
1.0000	0.0000	61.2245	24.9958
1.0000	0.0000	74.5926	31.4104

Engle's ARCH Test

H	P-Value	Stat	C-Value
1.00	0.0085	35.4559	18.3070
1.00	0.0053	48.4310	24.9958
1.00	0.0023	59.7615	31.4104

ARCH LM Test

 ARCH Test:

F-statistic	0.407029	Probability	0.0048114
Obs*R-squared	184.547	Probability	0.0043918

Post Estimation Analysis

The same Ljung-Box-Pierce Q-Test applies to the (innovations/sigmas) square residuals. It confirms there is no serial correlation exists.

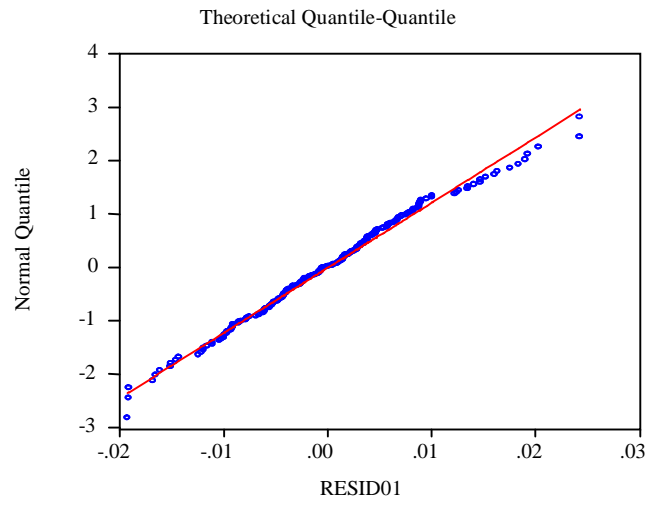
H	P-Value	Stat	C-Value
0	0.9952	2.1299	18.3070
0	0.9282	7.8873	24.9958
0	0.9770	9.4581	31.4104

Appendix-6**GARCH (1,1)**

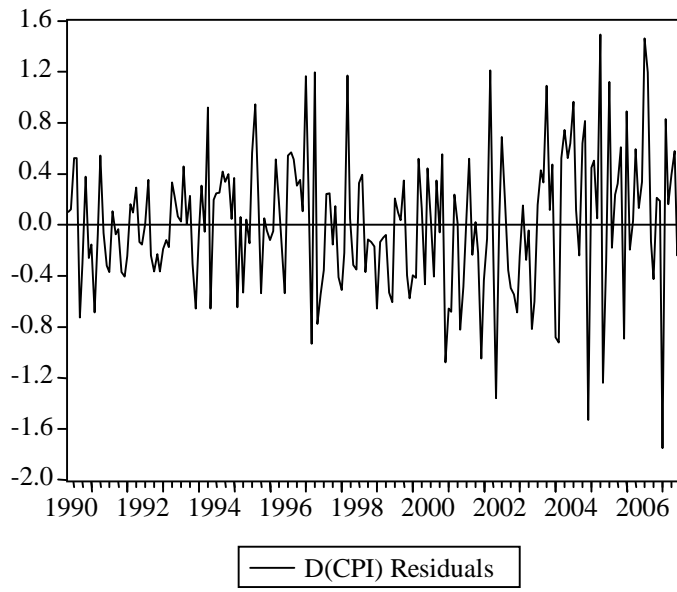
$$\text{GARCH} = \text{C}(3) + \text{C}(4) * \text{RESID}(-1)^2 + \text{C}(5) * \text{GARCH}(-1)$$

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.372052	0.051969	7.159164	0.0000
D(CPI(-3))	0.253261	0.066743	3.794536	0.0001
Variance Equation				
C	-0.001405	0.001250	-1.124577	0.2608
RESID(-1)^2	0.001574	0.000930	1.692335	0.0906
GARCH(-1)	0.912191	0.008365	120.9994	0.0000
R-squared	0.81023	Mean dependent var		0.516280
Adjusted R-squared	0.62825	S.D. dependent var		0.558219
S.E. of regression	0.540399	Akaike info criterion		1.496127
Sum squared resid	58.99029	Schwarz criterion		1.576627
Log likelihood	-149.8491	F-statistic		44.52392
Durbin-Watson stat	1.920719	Prob(F-statistic)		0.001806

Post Estimation Analysis*QQ Plot*



Residuals graph



*Appendix-7***EGARCH MODEL**

Dependent Variable: CPI

Method: ML - ARCH (Marquardt) - Normal distribution

Date: 11/17/08 Time: 22:06

Sample (adjusted): 1990M04 2007M04

Included observations: 205 after adjustments

Convergence achieved after 122 iterations

Variance backcast: ON

$$\text{LOG(GARCH)} = \text{C}(10) + \text{C}(11) * \text{ABS}(\text{RESID}(-1) / @\text{SQRT}(\text{GARCH}(-1)))$$

$$+ \text{C}(12) * \text{RESID}(-1) / @\text{SQRT}(\text{GARCH}(-1)) + \text{C}(13) * \text{LOG}(\text{GARCH}(-1))$$

$$+ \text{C}(14) * \text{D1}$$

	Coefficient	Std. Error	z-Statistic	Prob.
CM(-1)	0.002898	0.015403	0.188173	0.8507
CM(-2)	0.004257	0.016415	0.259339	0.7954
CPI(-1)	0.628035	0.113507	5.533020	0.0000
CPI(-2)	0.383178	0.114186	3.355719	0.0008
IP(-1)	-0.005942	0.005686	1.045049	0.2960
IP(-2)	0.004617	0.005125	0.900907	0.3676
M2G(-1)	0.002895	0.019437	0.148958	0.8816
M2G(-2)	0.017779	0.026466	0.671745	0.5017
C	0.059997	0.196759	0.304929	0.7604
Variance Equation				
C(10)	-0.347193	0.103587	-3.351711	0.0008
C(11)	0.638522	0.165502	3.858090	0.0001
C(12)	-0.289787	0.110599	-2.620162	0.0088
C(13)	0.974693	0.026978	36.12887	0.0000
C(14)	-0.706747	0.325207	-2.173225	0.0298
R-squared	0.996391	Mean dependent var		88.29178
Adjusted R-squared	0.996146	S.D. dependent var		28.66141
S.E. of regression	1.779402	Akaike info criterion		2.815318
Sum squared resid	604.7580	Schwarz criterion		3.042255
Log likelihood	-274.5701	F-statistic		4056.614
Durbin-Watson stat	2.292783	Prob(F-statistic)		0.000000

Book Review

Greif, Avner, *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*. Cambridge University Press, 2008, pp. 452, Price £19.99.

In a comparative study of the late medieval European and Muslim worlds, Greif analyzes the effect of institutions—especially those that facilitated impersonal exchange, such as trade—on the performance of modern economies. His argument rests on the premise that past institutions have an effect on consequent ones, and he contributes the disparity in performance of the Muslim and European economies to their distinct institutional trajectories. The book comprises several parts. It defines institutions in great detail; provides a comparative account of institutions in the medieval European and Muslim worlds; and applies a theoretical, analytical, and empirical framework—particularly game theory—to studying institutions.

The author identifies long-distance trade in the late medieval period as the driving force behind economic progress. He conjectures that institutions initiated and contributed to the expansion of international trade in this era. Greif explains from a historical perspective how reputation-based economic institutions enabled *Maghribi* (Western) traders to trade in the eleventh century. He emphasizes the importance of these institutions by acknowledging that pre-modern trade involved merchants supplying their goods abroad by entrusting their business to overseas agents; he argues that, without institutional support, international trade would not be possible as agents were likely to indulge in opportunistic behavior and embezzle merchants. Greif explains how the detection of opportunistic behavior through information sharing among merchants was intrinsic to the reputation-based institution, and the conditionality that merchants in that group would not hire dishonest agents in the future. Through game theoretical analysis, he shows how merchants ensured their agents' honesty by making future employment attractive through per-period premium payments. He concludes, however, that the *Maghribi* coalition in the long run proved to be inefficient as agents were more concerned about their actions and the consequences than profit maximization.

One of the political institutions examined in this book is the “*podestria*” in Genoa during the late medieval period. Greif describes the *podestria* system as a limited government in which a committee of

representatives hired a *podesta* (translator) to serve as Genoa's military leader, judge, and administrator. Greif highlights how the *podesta* had the desired effect of bringing peace to Genoa by deterring each clan from attacking the other to gain control of the city through the threat of intervention. He argues that, because the *podestria* was based on the balance of military strength among clans, and that each clan wanted to be militarily prepared in case of need, it helped contain but not eliminate inter-clan rivalry. Greif concludes, however, that, in the long term, this institution proved to be unsuccessful in undermining clan culture.

The author also studies the impact of culture on institutional development and path dependence. He argues that institutions persist in spite of exogenous changes due to a network of externalities, sunk costs, and coordination costs. He highlights how organizations in Europe—in the form of corporations—in contrast with the Muslim world in the medieval era, were based on interest rather than kin. Greif argues that European institutions in the late medieval period were so strong that, even in the absence of legal contracts, property rights were secure enough to allow merchants to travel to foreign lands without their wealth and trusted agents to handle goods on their behalf internationally. With the help of a historical and theoretical analysis, he shows how impersonal exchange in pre-modern Europe was supported by institutions based partly on law and partly on reputation; it was known as the community responsibility system. He explains how, under this system, each merchant paid a fee to receive information about an agent's past conduct and that dishonest agents were brought to compensate traders on condition that their past experience would not be revealed to potential future merchants.

The analysis in this book shows that contemporary developing economies such as the Muslim world are collectivist in nature whereas the West/developed world—in common with Medieval Latin society—is individualistic. Greif highlights how, in developing countries, the social structure is segregated: members of different groups remain insular and do not trade with each other, while contract enforcement is achieved through informal institutions. In developed countries, on the other hand, economic exchange takes place between individuals from different groups and formal institutions such as courts facilitate contract enforcement. He highlights how tribes and ethnic groups continue to remain prominent in the Muslim world's kin-based social structure, and how consanguineous marriages—aiming to preserve lineage and wealth—remain popular in the Muslim Middle East and North Africa even today. In an in-depth study of religious institutions, Greif shows how medieval Christianity supported the ideas of

individualism while Islam did not, for instance, advocating communal prayer over individual.

Greif indicates that good institutions foster an environment conducive to specialization and exchange by securing contracts and protecting property rights, and facilitate production by encouraging savings, investment in human and physical capital, and technological development. He correlates stronger rule of law, greater trust, and secure property rights with better economic outcomes. He argues that countries that developed their formal legal order internally and adapted imported codes to local conditions ended up with far stronger legal institutions than those that adopted codes exactly from the West. Many critics believe that International Monetary Fund (IMF) policies are ill suited to the needs of the developing world for this reason.

The collectivist nature of the Muslim world described by Greif can be compared with present-day Pakistan, where tribal kin-based social structures prevail in regions such as the Federally Administered Tribal Areas (FATA) and in Balochistan. Consanguineous marriages remain highly popular in Pakistan even today. Informal institutions such as *panchayaats* (courts) continue to play a significant role in some parts of Pakistani society, especially tribal areas. The reputation-based institutions described by Greif are an intrinsic part of Pakistani culture, which places a great deal of emphasis on “honor.” The age-old tribal custom of “*watta satta*” is a prime example of informal institutions, where a brother and sister in one family are married to a sister and brother in another, to ensure that the contract of marriage is enforced: this leads to a host of social ills. This closed insular social setup inhibits the growth of the economy. Nonetheless, the author underscores how collective responsibility can play a vital role for developing economies in microfinance, if used constructively, i.e., by using the insights provided by a historical analysis of the sociocultural setups of various communities. This argument is best understood by the success of the Grameen Bank in Bangladesh.

The book makes a valuable contribution to the field of institutional economics by presenting a unique game theoretical framework within which to study the effects of institutions on economies; the author writes from sociological, historical, and economic perspectives to explain the performance of contemporary economies. The book is reader-friendly and useful to students of any discipline. Greif assumes no prior knowledge of institutional economics and game theory, and describes both throughout his book and especially in the appendices.

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Nazia Mansoor

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