©The Pakistan Development Review
55:1 (Spring 2016) pp. 15–28

An Empirical Analysis of the Implicit Growth Rate for Industrial IPOs Listed in Pakistan

MUHAMMAD ZUBAIR MUMTAZ, ZACHARY ALEXANDER SMITH, and ATHER MAQSOOD AHMED

This study examines the cash flow growth rate implicit by offer prices of industrial IPOs using a reverse engineering DCF model. In addition, this study also investigates the bias of implicit growth relative to the realised growth rate by considering 19 IPOs listed on Karachi Stock Exchange during the period from 1995 to 2008. We find that the estimated growth in cash flows is slightly higher than realised growth rate, which indicates that the median IPO firm is overvalued by 61.5 percent at the offering. It is observed that estimation errors increase as a result of higher underpricing and diversified ownership. In addition, post-IPO returns are smaller for issues whose implicit growth rates are biased upward. We also find that IPOs underperform in long-run employing a buy-and-hold investment strategy. The policy implication of the study is to evolve a price discovery mechanism by the Securities and Exchange Commission of Pakistan which may help to reduce the overvaluation of IPOs upto some extent.

JEL Classification: G00, G30
Keywords: Initial Public Offerings, Reverse Engineering DCF Model, Valuation, Growth Rate

I. INTRODUCTION

The decision of when and at what price to take a company public is one of the most important decisions that the owners of the firm have to contend with over the indefinite life of the firm. Since the unseasoned equity shares do not have a publicly traded track record firms and investors alike are sometime left with a very non-descript portrayal of what the company should be priced at; however, the money at stake, for investors investing in the new issue and for owners attempting to exit the firm or trim their exposure to the issue is substantial. As companies issue new shares there will be winners and losers, but question pertaining to who wins and who loses is typically found out in the aftermarket. Analysts, investors, researchers, institutions, and companies have devoted many thousands of hours to study and examine how new issues should be priced

Muhammad Zubair Mumtaz <zubair@s3h.nust.edu.pk> is Assistant Professor, School of Social Sciences and Humanities, National University of Sciences and Technology, Islamabad. Zachary Alexander Smith <zacharyasmith@gmail.com> is Adjunct Professor, Donald R. Tapia School of Business, Saint Leo University, USA. Ather Maqsood Ahmed <ather.ahmed@s3h.nust.edu.pk> is Professor, School of Social Sciences and Humanities, National University of Sciences and Technology, Islamabad.

and the techniques practitioners and academics should use to price these issues; this paper extends this analysis focusing on a unique data set and the application of two unique methodologies to explore both the determinates and the magnitude of underpricing of Industrial IPOs issued on the Pakistani Markets.

Investors, practitioners, and academics have applied different valuation methods to attempt to gain a better understanding of the value locked within the newly issued IPOs (e.g. dividend discount, discounted cash flow (DCF), earnings capitalisation and residual income). Although countless studies [Ritter and Welch (2002); Sohail and Nasr (2007); Song, Tan and Li (2014)] have concluded that statistically and economically significant abnormal performance, on average, can be obtained over the short-run by investing in IPOs, identifying which IPOs to invest in is still a somewhat mysterious and seemingly unfruitful endeavor. Kojima (2007) and Chemmanu, *et al.* (2009) argued that private information is used to determine the value of the newly issued IPOs and this private information segregates the firms into groups that are performing well and those that are not performing well. The main difference between institutional and individual investors is how they interpret the readily available public information [Barber and Odean (2008)]. All investors would rather participate in the newly issued shares of IPOs that perform the best—institutional investors seem to have a better record obtaining higher returns. Individual investors have the same access to public information that the institutional investors have access to, but they misinterpret the available information related to firm value. Field and Lowry (2009) argued that institutional investors leverage their wealth and size to do detailed analyses of IPOs to determine the intrinsic value of the firm and individuals have limited resources and attempt to value the new issues on their own.

Empirically, there are two methods that have been used to value newly issued IPO shares: (i) direct valuation, which is based on an assessment of the fundamentals of the firm, and (ii) relative valuation, which is focused on estimates based on the prices of comparable firms. Even if the best technique to value the IPOs is chosen valuing the IPOs are difficult due to the IPO timing decisions that firms make based upon the "windows of opportunity" hypothesis. According to Loughran and Ritter (1995), the companies in same industry that issue their shares in a period of market buoyance tend to be overvalued. This implies that investors receive higher compensation for their shares relative to the risk that they take on when the relative valuation approach is employed. These firms float their unseasoned shares and posit that the growth possibilities along with optimistic valuations will lead to outperformance. As a result, managers manipulate their accounting numbers to provide an optimistic depiction of their firm's financial position, which leads to overvaluation of the IPO.

To estimate the value of IPOs, Kaplan and Ruback (1995) suggested that the DCF model provides the best results when compared against other methods. According to Cassia, *et al.* (2004), investment banks utilise different approaches to determine where to price IPOs (i.e. relative valuation is used 87 percent of the time and the DCF method 80 percent of the time. Purnanadam and Swaminathan (2004) argued that overvalued IPOs may earn excessive initial returns, but underperform in long-run. This implies that they use optimistic growth forecasts and focus less on the firm's profitability when underwriters attempt to value the IPO. When examining US IPOs, researchers have found that the median firm is overvalued by 50 percent relative to their industry peers

[Purnanadam and Swaminathan (2004)]. Further, Deloof, *et al.* (2009) suggested that the discounted Firm Free Cash Flow (FFCF) approach to valuation, a commonly used method, creates an unbiased value estimate. Rossenboom (2012) proposed that the use of different methods generates a positive bias relative to the equilibrium market value because the underwriters deliberately discount the fair prices.

Cogliati, *et al.* (2011) developed a reverse engineering DCF model to investigate the growth rate implicit in IPO prices. They considered 184 IPOs from 1995 to 2001 and reported that the cash flow of IPO firms grew at an average rate of 33.8 percent, annually, over a 5-year period. The estimated cash flow growth rate is higher than the realised rate (i.e. median estimated vs. realised: 21.5 percent vs. 1.8 percent). Additionally, the estimates of the short-term implied growth rates have been shown to be inversely related to long-run IPO performance [Cogliati, *et al.* (2011)]. They also contend that long-term IPO underperformance is caused by underpricing and book-to-market inflating estimation errors which occurs due to underpricing, leverage, book-to-market, size and age of the firm.

The objectives of this study are to: (a) investigate whether or not the growth rate implied in the offer prices of industrial IPOs are accurate, and (b) identify the determinants of long-run IPO performance and estimation errors over 3- and 5-year periods using the Extreme Bounds Analysis (EBA) technique. Earlier studies that have attempted to identify the implicit growth rate assumptions embedded in IPO prices have segmented their initial sample into two general categories (i.e. financial and non-financial IPOs), because financial firms and non-financial firms record and classify their financial information in different ways. The non-financial firms are then included in the sample and the financial firms are at times discarded. Next, at times, they have classified the remaining firms as either 'service firms' or 'industrial firms'. The reason that the present study focuses explicitly on industrial IPOs in this analysis is because the industrial firm is considered the backbone of an emerging market's economy. Because industrial firms act as a catalyst in the development of any country we focus this study on identifying the implicit growth rate of these firms. This study adds to the existing literature as it is the first attempt in the emerging markets to examine the growth rate embedded in industrial IPO offer prices.

II. IPOs IN PAKISTAN

In the Pakistani market, the issuance of unseasoned IPO shares is not a new proposition for firms that desire to raise the capital. M/s Hussain Industries, a company limited in shares, took the initiative to become the first to issue its prospectus in 1953 inviting subscription from the general public. From 1953 to 1990, the pace of IPO issuance remained sluggish throughout the country. As a result of liberalisation, deregulation, and the privatisation process, there were various reforms that the government undertook in 1991 to strengthen the efficiency and transparency of the capital market. To improve the financial market, the Securities and Exchange Commission of Pakistan (SECP) was established in 1997. The SECP began its operational functions on January 1, 1999 which were to execute the reforms in the capital market to make the process of going public more efficient. These changes created a more robust environment for private companies introduce their shares to the public.

According to SECP, 137 IPOs were issued from January 1995 to December 2008 with a paid-up capital of Rs 156.668 billion. In Pakistan, firms used two methods namely; (a) Fixed price method, and (b) Book building mechanism, to issue unseasoned IPO to the general public.

Table 1

IPOs in Pakistan (1995 – 2008)

Year	IPOs	Amount of Capital Raised (Billion PKR)	IPOs	
			Industrial	Non-industrial
1995	41	17.895	16	25
1996	30	12.041	13	17
1997	4	2.270	2	2
1998	1	0.221	0	1
1999	0	–	–	–
2000	3	2.035	1	2
2001	4	3.005	1	3
2002	4	6.318	1	3
2003	4	1.858	1	3
2004	9	55.654	2	7
2005	14	22.635	5	9
2006	3	3.961	0	3
2007	11	14.563	4	7
2008	9	14.232	3	6
Total	137	156.688	49	88

Source: Securities and Exchange Commission of Pakistan.

The Karachi Stock Exchange ("KSE") was established on 18th September 1947 with the paid-up capital of Rs 108 million. The activity on the KSE was very slow but with the passage of time, number of listed companies as well as paid-up capital increased. Initially, there were 90 members and 13 listed companies which later on rose to 291 over the next 10 year period. This increase was, among other things, the result of the process of industrialisation throughout the country. As a result of attractive policies, the stock market expanded enabling the government to attract more investments in 1992. The stock market, however, crashed in 1995 owing to political crises but an improvement was shown by the KSE over the next few years (i.e.1997 and 1998). The KSE was the best performing stock market in the world in 2002. As of mid-March, 2005, the KSE-100 index reached a high of 10,303 points due to improving economic fundamentals. This performance was attributed to a government privatisation process which attracted investment in PTCL and National Refinery. The market then maintained its strong performance in 2006 crossing the index level of 12,000 points. In April 2008, the KSE crossed 15,000 points showing a substantial growth but collapsed in that same year in August—the index fell to 5,000 points due to overall global economic slowdown. The KSE index, however, slowly but persistently rose thereafter. In June 2015, the KSE reached the height of more than 35,456 points repossessing the confidence and interest in the investors.

III. ANALYTICAL FRAMEWORK

Earlier research argued that underwriters consider different methodologies for estimating new issues [Cogliati, *et al.* (2011)]. The DCF or comparable multiples are traditionally used to price IPOs. The total cost of the capital is a blend of equity and debt measured by Weighted Average Cost of Capital (WACC), presuming that financial capital remained constant. Hence, capital cost does not change and WACC is the same throughout the specified period.

Following the DCF model, the Enterprise Value at time t (EV_t) is estimated as the present value of expected FFCF (i.e. $E_t[FFCF_{t+i}]$) based on the available information and subsequently discounted based upon the firm's business risk. Outstanding debt at time t (D_t) is deducted from the firm's value and then the expected equity value (E_t) is obtained. To terminate the ongoing concern, the values of future cash flows are determined over an infinite period. Like other direct valuations, the DCF model segregates the future into two periods. Penman (2007) suggested that valuations are generally equal to indefinite forecasting periods. The estimation of the going concern is based on indefinite time period whereas in practice it transacts over finite horizons. Initially, the firm is projected to grow at a 'non-constant' growth rate but eventually as the firm matures; they will reach a growth of 'steady state'.

$$EV_t = \sum_{i=1}^{\infty} \frac{E_t[FFCF_{t+i}]}{(1+WACC)^i} = \sum_{i=1}^{T} \frac{E_t[FFCF_{t+i}]}{(1+WACC)^i} + \sum_{i=T+1}^{\infty} \frac{E_t[FFCF_{t+i}]}{(1+WACC)^i} \quad \dots \quad (1)$$

Let

$$E_t[FFCF_{t+i}] = E_t[FFCF_{i+T}].(1+g_2)^{i-T} \; \forall \, i = T+1, \dots\dots\dots \infty$$

$$EV_t = \sum_{i=1}^{T} \frac{E_t[FFCF_{t+i}]}{(1+WACC)^i} + \sum_{i=T+1}^{\infty} \frac{E_t[FFCF_{i+T}].(1+g_2)^{i-T}}{(1+WACC)^i} \quad \dots \quad \dots \quad \dots \quad (2)$$

It is classified as two-stage because the growth rates of the cash flows before and after the event may be different. The extra growth (g_1) is supposed to grow annually at a constant rate. EV_t is combination of five elements: (i) $FFCF_t$, (ii) T= length of first stage growth, (iii) g_1 = first stage growth, (iv) g_2 = second stage growth, and (v) $WACC$. Referring Equation 2:

$$E_t[FFCF_{t+i}] = FFCF_t.(1+g_1)^i \; \forall \, i = 1, \dots\dots T$$

$$EV_t = \sum_{i=1}^{T} \frac{FFCF_t.(1+g_1)^i}{(1+WACC)^i} + \sum_{i=T+1}^{\infty} \frac{FFCF_t.(1+g_1)^T.(1+g_2)^{i-T}}{(1+WACC)^i} \quad \dots \quad \dots \quad (3)$$

$$EV_t = FFCF_t \left[\sum_{i=1}^{T} \left(\frac{1+g_1}{1+WACC} \right)^i + \left(\frac{1+g_1}{1+WACC} \right)^T \sum_{i=1}^{\infty} \left(\frac{1+g_2}{1+WACC} \right)^i \right] \quad \dots \quad (4)$$

Using DCF model to price IPO ($t = IPO$), actual $FFCF$ at IPO ($FFCF_t \equiv FFCF_{IPO}$) is used to find cash flows after IPO. To apply the DCF model, g_1 and g_2 are applied to cash flows before IPO for calculating $FFCFs$. Considering the assumptions, EV_{IPO}[1] is estimated by adding DCF expectations expressing as a function of the cash flow at the IPO. Referring Equation (4), $t = IPO$

[1] $EV_{IPO} = E_{IPO} + D_{IPO} - CI_{IPO}$ where $CI_{IPO} = \rho_{IPO}.NSH_{new}$ and $\rho_{IPO} = (EV_{IPO} - D_{IPO}) / NSH_{pre}$

$$EV_{IPO} = FFCF_{IPO}\left[\sum_{i=1}^{T}\left(\frac{1+g_1}{1+WACC}\right)^i + \left(\frac{1+g_1}{1+WACC}\right)^T \sum_{i=1}^{\infty}\left(\frac{1+g_2}{1+WACC}\right)^i\right] \quad \ldots \quad (5)$$

Equation (5) estimates the current value of the IPO through firm related variables. However, it is not suitable to use this estimation technique to value high-tech business with no earnings. To resolve this problem, Cogliati, *et al.* (2011) developed the reverse engineering DCF model to find the growth rate that is implicit in offer price upon the availability of public information from each investor:

$$\rho_{IPO} = \frac{FFCF_{IPO}}{WACC.NSH_{pre}}\left[\frac{(1+g_1)[(1+WACC)^T - 1 + (1+g_2).(1+g_1)^{T-1}]}{(1+WACC)^T}\right] - \frac{D_{IPO}}{NSH_{pre}} \quad \ldots \quad \ldots \quad (6)$$

Where ρ_{IPO} = offer price
NSH_{pre} = number of existing shares prior to the IPO
D_{IPO} = outstanding debt,
$FFCF_{IPO}$ = firm free cash flow before IPO[2]
$WACC$ = weighted average cost of capital[3]
g_1 = an undefined estimator of first stage growth where T is presumed 5 years for all firms
g_2 = a stable constant growth after the end of first stage[4]

These parameters are estimated from the IPO prospectuses and financial statements. Ex-ante expectations are compared by actual ex-post value using Estimation Errors $(EE_{i,j})$.

$$E_{IPO}\left[FFCF_{i,j}\right] = FFCF_{IPO,j}.(1+g_1)^i$$

$$EE_{i,j} = \frac{FFCF_{IPO,j}.(1+g_1)^i - FFCF_{i,j}}{FFCF_{IPO,j}.(1+g_1)^i} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

Extending the analysis, the researchers contrasted offer prices (P_{IPO}) to fair value estimates. Cogliati, *et al.* (2011) argued that the fair value at the IPO (υ_{IPO}) depends upon actual ex-post realisations of cash flows over a 5-year period rather than pre-IPO cash flows. This indicates that the actual ex-post realisation of cash flows is determined by underwriters' at the IPO may have been perfectly fair depending on the information relating to growth prospects of the firm at that time. Hence, Over Valuation Index (OVI)[5] is expressed in the following equation:

$$Over\ Valuation\ Index = \frac{P_{IPO} - \upsilon_{IPO}}{P_{IPO}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

[2]FFCF is calculated as: Cash flow from operating activities + Interest (1 – tax rate) – Capital expenditures.

[3]$WACC = \frac{E_{IPO}}{D_{IPO}+E_{IPO}}.K_E + \frac{D_{IPO}}{D_{IPO}+E_{IPO}}.K_D$ where E_{IPO} = market values of equity, D_{IPO} = outstanding debt, K_E = cost of equity capital through CAPM: $K_E = r_f + \beta_E(r_m - r_f)$ where r_f = risk-free rate, r_m = market return, β_E = firm's levered beta and K_D = cost of debt.$(1-t_c)$. where t_c = corporate income tax rate.

[4]Estimated using historical growth of real GDP in Pakistan—a nominal long-term growth rate for all firms assumed as constant equals 4 percent.

[5]$P_{IPO} = \frac{EV_{IPO} - D_{IPO}}{NSH_{pre}}$ $\upsilon_{IPO} = \frac{EV_{IPO}^{actual\ FFCF} - D_{IPO}}{NSH_{pre}}$

Estimated growth in cash flows is higher than actual realisation reflecting that this bias may specify an opportunity to make profit for investors (e.g. to examine the underperformers' ex-ante). This study extends this analysis to determine whether estimation errors and implied growth are correlated with post-IPO returns. Long-run IPO performance is investigated using buy-and-hold abnormal return (BHAR) methodology employed by Loughran and Ritter (1995).

$$BHAR = \frac{1}{n}\sum_{i=1}^{n} \left[\prod_{t=1}^{T}(1 + R_{i,t}) - \prod_{t=1}^{T}(1 + R_{m,t})\right] \quad \ldots \quad \ldots \quad (9)$$

Where

$R_{i,t}$ = return of stock i at time t
$R_{m,t}$ = return on KSE-100 index
n = Number of IPOs

Aftermarket performance is measured over 3- and 5-year period excluding first 21-trading days after IPO issuance to avoid potential bias from the price stabilisation period. It is, therefore, hypothesised that mean BHAR is equal to zero.

Researchers have identified various explanatory variables that affect long-run IPO performance using different techniques, for instance, Bayesian models, general to specific model, etc. To examine the sensitivity and robustness of explanatory variables of long-run IPO performance and estimation errors, the EBA technique [Leamer (1983)] is used. The model identifies variables that 'truly' influence the dependent variable and minimises the chances of model uncertainty upon choosing control variables. The model is described as:

$$BHAR_i = \alpha_0 + \sum_{j=1}^{n} \delta_i X_{ji} + \beta Q_i + \sum_{j=1}^{m} \gamma_i Z_{ji} + \varepsilon_i \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

where X = important variable(s) used in each regression, Q = variable of interest of which robustness is tested, and Z = a potentially important variable. Under EBA, a large of regressions is required to run and if a variable maintains a same sign being significant, it is treated as a robust variable.

To examine the growth implicit in industrial IPO offer prices, this study covers the period from 1995 to 2008. The following filters are used as: (1) The pre-IPO *FFCF* was positive (losing 8 IPOs), and (2) Cash flows are available for 5 years after the IPO (losing 10 IPOs). Out of 49 industrial IPOs, 18 were eliminated due to imposition of filters whereas 12 IPOs were extracted from the sample due to non-availability of information with regard to share prices as well as IPO prospectus. Hence, the final sample covers 19 industrial IPOs for which inverse the DCF model is used. The data is collected from the IPO prospectus and share prices and market index are gathered from the KSE database.

IV. EMPIRICAL FINDINGS

(a) Implied Growth Rates and Forecast Errors

Table 2 depicts that, on average, IPO firms are expected to grow by 38.0 percent annually over the five-year period after listing (Median: 16.6 percent). This finding implies that the growth rate embedded in offer prices are more than the realised growth rates, which reflects over-optimistic tendencies employed by the underwriters. This finding is in line with Cogliati, *et al.* (2011) reporting that, on average, IPO firms are expected to grow by 33.8 percent annually over five-year (Median: 21.5 percent). The median $CAGR_1$ of FFCF is reported at –208.3 percent representing that most of IPO firms faced a negative cash flow in the first year after listing. This indicates the sign of either intense investment behaviour or signal jamming behaviour because there is significant uncertainty embedded in these estimates. Signal jamming [Stein (1989)] represents negative FFCF illustrating capital expenditures made by the firm after listing. Therefore, the analysts' expectations are inaccurate resulting upward biased estimate. Over the 5-year period, cash flows of IPO firms increases leading median $CAGR_5$ into positive at 14.4 percent. Median estimation errors (EE_3) are 52.0 percent over 3-year and 38.3 percent over 5-year. This finding posits that the estimation errors occurred due to the difference between estimated and realised growth rate. Over a 3-year period, estimation errors are higher but realised growth might adjust over the 5-year period reducing the gap between estimated and realised growth rates. Aggregate EE_3 and EE_5 are reported at 78.2 percent and 67.2 percent respectively illustrating that IPO investment in long-run is not a viable strategy for Pakistani investors.

Table 2

Implied Growth Rates and Forecast Errors

	Average	StdDev	Median	Aggregate	Skewness	Kurtosis	JB	p-value
g_1	38.0	56.7	16.6		1.28	0.70	31.67	0.00
$CAGR_1$	n.s.	820.3	–208.3	–590.4	–0.48	–0.16	4.30	0.12
$CAGR_3$	–4.0	91.3	1.7	–17.0	–1.09	2.29	26.86	0.00
$CAGR_5$	–29.8	125.6	14.4	10.4	–1.32	0.49	33.27	0.00
EE_3	24.2	106.6	52.0	78.2	–1.73	5.11	77.69	0.00
EE_5	33.2	197.2	38.3	67.2	0.22	0.70	1.26	0.52
O.V.I.	65.2	69.0	61.5		0.62	–0.69	7.74	0.02

This table shows finding of 19 Industrial IPOs which was listed on KSE from 1995–2008.g_1 = short-term implied growth rate, CAGR = actual post-IPO cash flows, EE = estimation error and O.V.I. = overvaluation indices. The result of $CAGR_1$ is not reported due to negative $FFCF_1$after IPO. The aggregate CAGR is obtained by adding the cash flows of event firms. Aggregate estimation errors are determined by difference between sum of estimated and actual cash flows scaled with sum of estimated cash flows. All values are in percentages.

The results presented in Table 2 for the OVI variable illustrates that at the offering the median firm is overvalued by 61.5 percent relative to its ex-post value, which indicates that ex-post realised cash flows are rightly skewed. The difference between short-term implied growth rates (g_1) and the $CAGR_5$ is small (16.6 percent vs. 14.4 percent) which confirms the robustness of the model. Sensitivity and robustness of the model is tested by varying g_2 and T (results are presented at appendix). It is, thus, suggested that the reverse engineering DCF model effectively determines short-term implied growth in offer prices. The sensitivity analysis using various assumptions is examined to test the robustness of the results and found similar results. By applying the model, it predicts that short-term implied growth (g_1) strongly influences long-term growth rate (g_2) and T.

(b) Aftermarket Pricing Performance of IPOs

Aftermarket price performance of IPOs are examined over 3- and 5-year periods using BHAR adjusted benchmark return excluding first 21-trading days. The significance of long-run returns is determined by a skewness adjusted *t*-statistic [Lyon, Barber, and Tsai (1999)]. The results confirm that IPOs underperform by 36.8 percent (*t*-statistic: –2.46) and 74.6 percent (*t*-statistic: 3.19) over three- and five-year period respectively explaining that market index performs better than IPOs. To find the determinants of long-run underperformance and estimation errors, EBA technique is employed.

(c) Determinants of Long-run IPO Performance and Estimation Errors

Table 3 reports the estimation results without *Z*-variables. Panel A exhibits the determinants of long-run IPO performance over 3- and 5-year periods using eleven explanatory variables. *X*-variables are fixed variables to be included in each regression which are identified on the basis of prior studies [Leamer (1983)] significantly affecting long-run performance. *X*-variables includes short term implied growth rate (g_1) and Momentum while the robustness of the *Q*-variable is tested by considering three *Z*-variables in each regression using the Newey-West procedure. From the *X*-variables, g_1 is statistically significant variable in regression I and II that influence long-run performance. The negative affect of g_1 explains that higher growth is implicit in offer prices thereby reducing underperformance. Market momentum is only significant in regression II. The positive sign of Momentum indicates that the higher market returns relative to event firms inflates underperformance.

In both regressions I and II, Size is significant from the *Q*-variables illustrating that higher sales of event firms ultimately creates more demand reducing the level of underperformance. The magnitude of underpricing is significantly and positively affecting long-run performance in regression I and II describing that higher the level of underpricing more be the underperformance. Leverage is another important factor from the *Q*-variables which significantly and negative affect on long-run IPO performance. This implies that higher levered firms have more resources to perform efficiently thereby less underperform in long-run. In regression I, B2M is significantly affecting long-run IPO returns. B2M negatively relates to underperformance, depicting that the higher the book-to-market ratio the greater the chances of IPO underperformance as market index return increases, this evidence is contrary to earlier finding [Cogliati, *et al.* (2011)]. P/E is positively associated to underperformance but insignificant.

Table 3

Estimation Results of Benchmark Models

	Panel A: Long-run Performance			Panel B: Estimation Errors	
	BHAR year IPO + 3 (I)	BHAR year IPO + 5 (II)		EE_3 (III)	EE_5 (IV)
X-variables			**X**-variable		
g1	–0.8557	–1.7059	Participation	6.6408	2.4573
	(–3.82)***	(–3.27)***		(2.09)*	(0.72)
Momentum	0.9262	2.4106			
	(1.42)	(3.12)***			
Q-variables			**Q**-variables		
Size	–0.1046	–0.1028	Size	–0.0668	–
	(–1.86)*	(–2.82)**		(–1.04)	
Underpricing	0.2129	0.5390	Momentum	–1.5230	–
	(1.84)*	(2.51)**		(–0.97)	
Leverage	–0.2249	–0.2253	Underpricing	0.3193	–
	(–4.26)***	(–1.58)		(3.18)***	
P/E	0.1676	0.2950	B2M	–	–0.0797
	(1.20)	(1.58)			(–0.20)
B2M	–0.3012	–			
	(–3.29)***				
Constant	0.5531	–0.0907	Constant	0.1983	0.3126
	(2.05)*	(–0.51)		(1.77)*	(0.52)
Adj. R^2	0.2350	0.4728	Adj. R^2	–0.0703	–0.1150
F-value	9.84***	7.65***	F-value	3.97**	0.39

The table demonstrates the estimation results of benchmark model without Z-variable.

Panel A (I and II) identifies the model by considering different determinants of long-run IPO performance over 3- and 5-year period considering $BHAR_i = \alpha_0+\alpha_1 g_1+\alpha_2\, Momentum_i+\alpha_3 EE_i+ \alpha_4 Leverage_i+\alpha_5 Underpricing_i + \alpha_6 Dilution_i+\alpha_7 Participation_i+\alpha_8 Age_i+\alpha_9 B2M_i+\alpha_{10} Size_i+\alpha_{11} P/E_i+\epsilon_i$.

Panel B (III and IV) considers various determinants of estimation errors over 3- and 5-year period considering $EE_i = \alpha_0+\alpha_1 P/E_1+ \alpha_2 Participation_i+\alpha_3 B2M_i+ \alpha_4 Momentum_i+\alpha_5 Age_i+\alpha_6 Dilution_i +\alpha_7 Leverage_i +\alpha_8 Underpricing_i +\alpha_9 Size_i+\epsilon_i$.

Independent variables covers: g_1 = short-term implied growth rate, Momentum = market momentum, EE= estimation errors, Leverage = financial leverage prior to IPO, Underpricing = stock return on the first day of trading, Dilution = the ratio between newly issued shared and number of pre-IPO shares, Participation = the ratio of exiting shares to pre-IPO shares, Age = age of the firm, B2M = book to market ratio, Size = pre-IPO sales and P/E = price/ earnings ratio. Using EBA technique, those variables pass the sensitivity and robustness test are reported above. The t-statistics are based on Newey-West HAC standard errors. ***, ** and *denote significance level at the 1, 5 and 10 percent respectively.

Panel B reports the determinants of estimation errors over 3- and 5-year periods. In regression III and IV, Participation is considered as the X-variable. This implies that a higher participation in IPOs over a broader population may lead to agency problems, which inflates estimation errors. The effect of Participation is significant in equation III but not in IV. Among Q-variables, underpricing is positive and significant in regression III indicating that higher underpricing may generate more estimation errors whereas Size and Momentum are not significant. In regression IV, B2M is negatively related to EE_5 but insignificant depicting that the difference between market and book value of equity at the IPO are priced on the basis of growth prospects and therefore create low estimation errors. The estimation results including all Z-variables are not presented for the sake of brevity.

(d) Comparison of the EBA Technique with other Traditional Methods

This section compares the results of the traditional econometric methods and the EBA technique to inquire about the general model of long-run performance over five years is stable across comparable econometric techniques. The traditional methods comprised: (a) the Akaike's information criterion (AIC), (b) the Schwarz's Bayesian information criterion (SBIC), (c) the Hannan-Quinn information criterion (HQIC), and (d) the general to specific (GTS) methodology. Using AIC, SBIC and HQIC techniques, the objective of the researchers is to select model having lower value of information criteria which reduces standard errors. When GTS methodology is used, a number of variables selected are trimmed accordingly to reach at a parsimonious model thereby ignoring those variables having the lowest explanatory power. Table 4 presents the comparison of the EBA technique vis-à-vis other traditional methods employed to selecting the explanatory variables of long-run IPO performance over the period of five years.

Table 4

Comparison of the EBA Technique with other Traditional Econometric Methods

Regression	AIC	SBIC	HQIC	GTS	EBA
Constant	–0.2080	–0.2080	–0.0907	–0.0907	–0.0907
	(–0.69)	(–0.69)	(–0.51)	(–0.51)	(–0.51)
g_1	–1.6641	–1.6641	–1.7059	–1.7059	–1.7059
	(–2.62)**	(–2.62)**	(–3.27)***	(–3.27)***	(–3.27)***
Momentum	2.3956	2.3956	2.4106	2.4106	2.4106
	(2.03)***	(2.03)***	(3.12)***	(3.12)***	(3.12)***
Size	–0.1160	–0.1160	–0.1028	–0.1028	–0.1028
	(–1.89)*	(–1.89)*	(–2.82)**	(–2.82)**	(–2.82)**
Underpricing	0.3974	0.3974	0.5390	0.5390	0.5390
	(1.53)	(1.53)	(2.51)**	(2.51)**	(2.51)**
P/E	0.3035	0.3035	0.2950	0.2950	0.2950
	(1.37)	(1.37)	(1.58)	(1.58)	(1.58)
Leverage	–	–	–0.2253	–0.2253	–0.2253
			(–1.58)	(–1.58)	(–1.58)
Adj. R^2	0.4764	0.4764	0.4728	0.4728	0.4728
F-value	5.60***	5.60***	7.65***	7.65***	7.65***

The table depicts the comparison of estimation results between traditional methods and EBA technique derived from the OLS over the period of five years using buy-and-hold abnormal returns. AIC = Akaike's Information Criterion, SBIC = Schwarz's Bayesian Information Criterion, HQIC = Hannan-Quinn Information Criterion, GTS = General to Specific methodology and EBA = Extreme Bounds Analysis. Dependent variable includes: BHAR = buy-and-hold abnormal returns over five year period whereas independent variables comprise g_1 = short-term implied growth rate, Momentum = market momentum, Size = size of the firm, Underpricing = initial return on listing day, P/E = price-earnings ratio and Leverage = leverage of the firm. ***, ** and *denote statistical significance at 1, 5 and 10 percent level respectively. *t*-values are shown in parentheses.

The finding of the results using traditional econometric methods and EBA suggest that all the techniques are providing almost the same result, when one method is used over the other. The AIC and SBIC identified five variables while the other methods selected six variables that are affecting long-run performance. The short-term implied growth rate (g_1), market momentum and size of the firm are statistically significant across all econometric techniques. Underpricing of IPO is also significant variable using HQIC, GTS and EBA techniques. P/E is not a statistically significant variable identified by all the methodologies. Leverage is identified by HQIC, GTS and EBA methods but insignificant on the long-run performance of IPOs.

According to Davidson and MacKinnon (2004), the AIC does not suggest the parsimonious model due to the fact that is based on log likelihood function but Stock and Watson (2007) argued that AIC provides better results relative to SBIC. Hurrich and Tsai (1989) pointed out using SBIC and HQIC techniques for model specifications are order consistent and not appropriate like the AIC. With regard to GTS methodology, Lovel (1983) posited that there is no assurance that the particular specification relates to true specification due to unknown distributional properties with multiple testing. The EBA technique is considered more appropriate as it robustly identifies a variable which passes the sensitivity test after running thousands or millions of regression. Though it has some flaws but its criterion for identifying the variables is so rigorous actually affecting the long-run performance.

We conclude that every econometric method has its own build-in features to select the model specification but interestingly their results are almost the same. We may emphasise that EBA technique reduces the ambiguity for selecting the true variables that affect dependent variable.

V. CONCLUSIONS

To value unseasoned issues, various methodologies have been developed. Among others, DCF is found the most popular method. We employ the reverse engineering DCF model [Cogliati, *et al.* (2011)] to determine that the growth rate is implicit in offer prices of Industrial IPOs having positive FFCF issued on KSE from 1995 to 2008. Applying this technique, we found that the cash flow of the average IPO firms is expected to grow by 38.0 percent annually over five-year period showing that actual CAGR of cash flow is less than expected. It is also found that median IPO firm is overvalued by 61.5 percent which is consistent with prior studies [e.g. Colgiati, *et al.* (2011) and Purnanadam and Swaminathan (2004)]. The biasedness in the results of the estimated and realised growth rate leads to estimation errors which suggest higher underpricing [i.e. abnormal excess returns of 25.6 percent—this finding corroborates the earlier studies on Pakistani IPOs [Sohail and Nasr (2007); Sohail and Rehman (2010); Kayani and Amjad (2001)] and broad class of investors' participation. Thus, overestimation may deteriorate in the aftermarket performance of IPOs. Moreover, the robust predictors that caused long-run IPO performance include: (a) higher short-term implied growth rates, which lead to smaller post-IPO returns, (b) market momentum is positively associated with aftermarket performance, (c) IPOs that have lower book-to-market ratios perform better, (d) firms that have high sales volumes tend to have low levels of underperformance, and (e) low level of leverage posit that IPO firms less underperform. This study will act as a catalyst for the policy-makers, researchers, investors and firms to reduce the overvaluation of unseasoned issues. By overcoming the overvaluation and the factors affecting long-run performance, unseasoned issues may become more attractive in Pakistani market. The policy implication is that SECP has to adopt those measures which may improve the price discovery mechanism. This may help to minimise the overvaluation made by the underwriters. However, the selection process of underwriter should be more rigorous to ensure that they should arrive at a price which may be market competitive to have a fair competition after its listing.

REFERENCES

Barber, B. and T. Odean (2008) All that Glitters: The Effect of Attention on the Buying Behaviour of Individual and Institutional Investors. *Review of Financial Studies* 21, 785–818.

Cassia L., S. Palcari, and S. Vismara (2004) The Valuation of Firms Listing on the Nuovomereato: The Peer Comparables Approach. *Advances in Financial Economics* 10, 113–129.

Cogliati, M. G. and S. Paleari (2011) IPO Pricing: Growth Rates Implied in Offer Prices. *Annals of Finance* 7:1, 53–82.

Davidson, R. and J. G. MacKinnon (2004) *Econometric Theory and Methods*. Oxford University Press.

Deloof, M. W. De Maeseneire, and K. Inghelbrecht (2009) How do Investment Banks Value IPOs? *Journal of Business Finance and Accounting* 36:1 and 2, 130–160.

Field, L. C. and M. Lowry (2009) Institutional versus Individual Investment in IPOs: The importance of Firm Fundamentals. *Journal of Financial and Quantitative Analysis* 44, 489–516.

Hurrich, C. M. and C. L. Tsai (1989) Regression and Time Series Model Selection in Small Samples. *Biometrika* 57, 297–307.

Kaplan, S. N. and R. S. Ruback (1995) The Valuation of Cash Flow Forecasts: An Empirical Analysis. *Journal of Finance* 50, 1059–1093.

Kayani, S. and S. Amjad (2011) Investor Interest, Underpricing and Trading Volume in Pakistan Secondary Market. *Business and Economics Journal* 39, 1–15.

Kojima, N. (2007) IPO Share Allocation and Conflicts of Interest. *Annals of Finance* 3, 369–387.

Leamer, E. E. (1983) Let's Take the Con Out of Econometrics. *American Economic Review* 73, 31–43.

Loughran, T. and J. R. Ritter (1995) The New Issue Puzzle. *Journal of Finance* 50, 23–51.

Lovell, Michael C. (1983) Data Mining. *The Review of Economics and Statistics* 65:1, 1–12.

Lyon, J. D., B. M. Barber, and C.-L. Tsai (1999) Improved Methods for Tests of Long-Run Abnormal Stock Returns. *Journal of Finance* 54:1, 165–201.

Purnanandam, A. K. and B. Swaminathan (2004) Are IPOs Really Underpriced? *Review of Financial Studies* 17:3, 811–848.

Sohail, M. K. and A. Rehman (2010) Examining the Short-Run IPOs Performance in State of Economy: Normal, Boom and Recession. *International Research Journal of Finance and Economics* 35, 173–186.

Sohail, M. K. and M. Nasr (2007) Performance of Initial Public Offerings in Pakistan. *International Review of Business Research Papers* 3:2, 420– 441.

Stein, J. (1989) Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behaviour. *Quarterly Journal of Economics* 104, 655–669.

Stock, J. H. and M. W. Watson (2007) *Introduction to Econometrics.* (Third edition). Pearson Publication.