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Asset Pricing Through Downside Risk Based Arbitrage Pricing Theory: Empirical Evidence from Pakistan Stock Exchange

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Abstract

This study extends the downside risk applications in multifactor asset pricing model by incorporating the downside risk spillovers from economic and financial factors to stock returns. We amplify the conventional APT model by replacing the variance-based betas with semivariance based downside betas that better capture the risk volatilities in varying market conditions. The inclusion of downside risk betas based on semivariance and semideviation methods in the augmented asset pricing model improves both the theoretical and methodological applications relative to the limitations and restriction of conventional APT factors model. The mean-variance hypothesis replaced by mean-semivariance hypothesis and asymmetric behaviour of stock returns distribution, empirically suggest the use of an alternative factors model. The models based on downside risk premia for asset pricing in emerging markets. The study tested the downside risk-return relationship based on the excess monthly stock returns of listed PSX firms and observed economic, financial and global factors representing spillover triangulation from 1997 to 2017. The findings of the study indicate that the augmented DR-APT model with pricing restrictions of unconditional linear factors method could not be deserted over the targeted period of study. The selected observed pricing factors except exports are significant enough for pricing the security returns in the augmented DR-APT Model. Findings of the panel regression, likelihood ratio tests and F-test corroborate DR-APT as a better model to price stock returns in volatile situations compare to conventional APT model. Our findings are consistent with the downside risk-return framework based on mean semi variance hypothesis and have implications for managers and decision markets that incorporate downside risk in asset valuation, cost of capital estimations, portfolio construction and investment analysis decisions.
Key Words: *Downside Risk, Semi variance, Semi covariance, Downside Beta, Downside risk-based Arbitrage Pricing Theory (DR-APT).*

Asset pricing in the context of Asset Pricing Theory is one of the main fragment of traditional and modern finance. Under this framework, several asset pricing models emerged over the period that is largely grouped into a single factor or uni-factor (i-e., CAPM, ICAPM, DCAPM) and multifactor (i-e., F&F, APT) asset pricing models. All these models either uni-factor or multifactor suggest that the return of any security is the function of its risk explained by the single or multiple factors measured by asset or security betas. These factors are categorized into macroeconomic, fundamentals, market, technical, sectorial, global and statistical factors. All these models document the risk in return generation process based on mean-variance behavior (MVB) instigated by (Markowitz, 1952; Tobin, 1958).

In the categories of multifactor asset pricing models (Ross, 1976) offered the Arbitrage Theory of Capital Asset Pricing named (APT) substitution to the single-factor capital asset pricing model. Under the APT framework, the return on financial assets or stocks is explained by various factors primarily macroeconomic factors such as GDP, Inflation, Interest Rate and Industrial Production etc. The later addition and modification of APT to model the asset or security returns as a linear function of various factors are extended from macroeconomic to financial and global factors (Azeez & Yonezawa, 2006). In the emerging market conditions, the extended framework reveals that the economic factors are the major driver of stock market movements and prices follow the country economic momentums (Naseem et al., 2019). The systematic impact of several economic factors on the company's stock prices and resulting returns reveals the implications of APT in Pakistan (Khan, Khan, Ahmad, & Bashir, 2018).

In the APT framework, the most important steps are the estimation, selection and measurement of various factors and their respective risk-based beta proxies. The empirical literature on APT manifest the various approaches and methodologies for the estimation and extraction of factors beta. The fundamental and most widely used is the application of factor analysis for factor extractions (Roll & Ross, 1980; Chen et al, 1986). The second most widely used approach for the selection of factor betas is the application of principal component analysis and maximum likelihood principle component analysis (Connor & Korajczyk, 1985, 1986 & 1988). The other alternative fundamental methodology to estimate the factor betas is based on the test of the sensitivity of a security or stock return to the group of economic and financial variables (Beenstock & Chain, 1988; Henriqeues & Sadorskey, 2001; Ouyssie and Kohan, 2010).

In this regard, recent amplification in asset pricing literature proposes the application and usefulness of downside side risk measures for asset pricing. These measures of semi-variance, semi-deviation, semi-covariance and higher-order co-moments are empirically useful in pricing stock returns in emerging markets. In contrast, the conventional measures of common beta and variance avowed as the inefficient measure of risk (Dittmar, 2002; Hwang & Satchell, 1999; Estrada, 2002, 2005, 2007; M. Glabadanidis & Baghdadabad, 2014). The traditional risk measures for pricing asset and portfolio constructions based on market risk or non-diversifiable risk empirically fails in case of single factor assets pricing models (Estrada & Serra, 2005; Post & Van Vliet, 2006).

In response to emerging market dynamics for asset pricing. Estrada (2002, 2005, & 2007) uncover that the investors and equity valuators in emerging markets are more concern with the downside risk in the valuation and pricing of capital assets. Estrada (2002) the average returns in developed equity markets in high volatility conditions and emerging equity markets are more affected by changes in downside risk beta compare to equal changes in common beta. Post and Levy (2005) accentuate that on the off chance that financial specialists show distinctive conduct for bear and positively trending markets. At that point, they are eager to pay a premium for stocks giving downside shield in bear markets and upside potential in buyer markets.

With compelling proof from both developed and emerging equity markets for non-normality of stock returns and investor inclination for downside risk quest new asset pricing model. The downside risk-based multifactor asset pricing model seems to be the ultimate alternative to common and traditional beta-based model both for theoretical and empirical contribution. The models that correctly uncover the reality of the risk-return relationship of finance theory. The models that incorporate the real value of losses from downward movements in stock prices and investors pain of loss. The models based on the correct ramification of risk losses capture by the dynamic measures of semi-variance, semi-deviation and semi-covariance-based downside betas.

The application and use of these dynamics models in asset pricing are empirically proved as a more plausible risk measure for many reasons; first, both theory and literature proved and suggest that the investors were more prone and hatred toward downside volatility compare to upside movements in volatile market conditions. Second, the semi variance, semi-deviation and semi-covariance are more useful and empirically proven measures of risk compare to traditional variance when the distribution of stock returns is asymmetric or non-normal. In past literature, the use of semi-variance, semi-deviation and semi-covariance in downside beta calculation was mostly performed on single factor asset pricing models alike CAPM (Estrada, 2002, 2005). Whereas, in case of multifactor asset pricing models none of the previous research in emerging and developed markets tested the mechanism of downside risk to investigate the association between security returns and beta factors in the APT framework.

The earlier studies on the multifactor asset pricing (APT) were based on the assumption of normality of stock return behavior in stock markets (Khan et al., 2018). The conventional risk measures that explain the variation in the stock returns were biased toward upside tail or volatility. These conventional measures such as variance, standard deviation and covariance propagate the inaccurate determination and measurement of risk losses. The downside risk approach based on the semi-variance and semi-deviation captures the risk of adverse outcomes or downside losses. This approach is more appealing and practical in emerging markets due to the asymmetric behavior of the stock returns. The theoretical and empirical applications of downside risk inclusion for asset pricing was tested mainly in case of CAPM related models. The results of these studies reveal that the downside risk based CAPM significantly explains the stock returns and had more explanatory power than conventional CAPM. In the case of multifactor asset pricing model, none of the previous studies was found to tests the application of downside risk in APT in the context of Pakistan. This research study is explicitly designed and targeted to bridge this research gap and suggests numerous empirical and methodological amplifications to asset pricing models and literature.

This research study is anticipated to make the following significant contribution to the empirical literature and provides a new framework for asset pricing. First, this study contributes to the literature on downside risk framework under the context of the multifactor asset pricing model, particularly the Arbitrage Pricing Theory. The empirical literature on asset pricing both single factor and multifactor is still in search of risk measure that better explain the variation in stock returns. In this stance, existing literature largely and exclusively focuses on an alternative measure of risk named as downside risk measured through semi variance, semi-deviation and semi-covariance. Estrada (2002) and Harvey (2000) report that semi-deviation and returns are positively and significantly related. Furthermore, Estrada (2000, 2002) and Harvey (2000) find a positive and significant relationship between returns and downside beta. Prior research largely ignored the pricing of stock return and cost of equity calculation in the context of downside risk assessed through semivariance and semi-deviation under the framework of Arbitrage Pricing Theory.

Second, the study also contributes to the literature on multifactor asset pricing particularly APT under the context of downside risk in emerging market dynamics. In recent years the use of downside risk measures in pricing assets and the construction of portfolios remain contestable among researchers of both emerging and developed economies. The use of standard mean-variance analysis in asset pricing and portfolio construction posit limitations in emerging markets. The underlying assumptions of the standard MVA approach require that returns must be normally distributed, however, this is in direct contradiction with the empirical evidence concerning the distribution of emerging market returns. Studies such as Bekaert et al. (1998) Discovers that emerging equity markets display significant skewness and kurtosis in their returns, while Bekaert (1995) and Harvey (1997) enlightened the degree of skewness and kurtosis alters over time. Such results indicate that the use of a standard mean-variance approach is questionable when emerging markets are under examination. This study is significant because it will contribute to the literature by providing a new method of multifactor asset pricing under the context of downside risk named as DR-APT for pricing stock return in emerging markets.

Finally, the study is significant in its stance that it extends previous research studies in the framework of a single factor asset pricing model to a multifactor asset pricing model based on downside risk. This study contributes to the literature by augmenting the conventional APT to DR-APT to investigate the relationship between combined factors such as economic, financial and global and stock returns in case of Pakistan. It is first studied to test this type of relationship in the framework of DR-APT none of the studies has tested this hypothesis previously in Pakistan. Based on the research gap this study is designed to answer the following main research question that is also transformed into a research hypothesis for empirical testing.

- Does the downside risk-based Arbitrage Pricing Theory (DR-APT) outperform traditional APT in measuring stock price returns of PSX based on multiple downside risk factors?

In light of the main research questions given above, the research study is designed to address the following key research objective;

- To empirically examine the performance of augmented (DR-APT) models using the concepts of factors downside beta, semi variance and semicovariance for selected PSX firms.

Literature Review

The study carried out on the capital markets of emerging and developed markets from 1970 to 2000 report that the semivariance and semi-covariance are the better measure of risk than variance (Estrada, 2002, 2004). The semivariance and semi-covariance method are effective to capture the maximum portion of expected returns and have greater explanatory power in risk-return mechanics. Estrada (2007) in its extended study recommended the augmented CAPM model based on the beta ratio of the inverse values. Utilizing the data of the capital markets of the emerging and developed markets from 1988 to 2000. The proxy beta ratio of the inverse values explicated the 55% of the capital market return volatility in the emerging markets and almost 44% of stock return volatility in the developed markets. The average stock return depicted a more sensitiveness to the variation of the negative beta values compare the variations of the conventional beta ratio. Furthermore, the downside risk methods in emerging markets perform better with skewed return distribution and enhanced the explanatory power of the underlying model.

The expected return comparison across developed and emerging markets based on downside risk indicates the relative findings. The emerging markets compared to developed markets realize the higher mean expected returns based on downside risk proxies. (Dobrynskaya, 2014; Post, Vliet 2004) confirm the higher significance of the negative beta ratio that is directly reflected in the average stock return of security or portfolio. (Dobrynskaya, 2014) the currency market analysis revealed that the higher level movements in the interest rates in the particular economy determines the increase in the level of currency downside risk and its impact on resulting asset pricing. (Jaama, Lam and Isa, 2011) the empirical study in the dynamics of Kuala Lumpur Stock Market based on downside risk insinuations on the efficiency of investment portfolios discloses decisive results. The findings report that the downside risk measure is the more effective measure of risk compared to the conventional mean-variance method. The methodology proposed in this study is proved to be the better option for various individuals' alike investors and portfolio managers want to avoid risk.

(Alles and Murray, 2013) the cross-sectional study of the association between downside risk-based methods and mean asset returns in growing Asian stock markets over the 10 years from June 1999 to May 2009. In contrast to past empirical studies, they split the entire example into two subsamples, comprising of analysis in the downturn and upturn periods. In the downturn (upturn) period, asset returns were underneath or over the targeted risk-free rate. In the two time frames, all downside based risk methods were valued. In the upturn or downturn period, the study found that the risk for downside beta was reasonably high. At the point when the upturn and downturn were joined, this premium ended up irrelevant.

Downside risk-based beta is a typical measure utilized by evaluators and researchers in downside risk estimation. Nonetheless, as per (Pedersen and Hwang 2007), downside risk based beta isn't a fitting proportion of downside risk in all stock or security markets. Numerous scholars have recommended other methods of downside based risk, to be specific downside co-skewness, drawdown risk method, value at risk (VaR) and conditional value at risk (CVaR). For instance, in the U.S. capital markets for the time frame from July 1963 to December 1993. (Harvey and Siddique, 2000) saw that contingent co-skewness elucidates the cross-sectional variability in expected stock returns and restrictive co-skewness seizure the asymmetry in targeted risk, specifically downside risk. (Galagedera and Brooks, 2007) confirm that downside co-skewness is better at describing the cross-sectional returns in twenty-seven developing markets than drawback beta with test periods starting in December 1987 else 1992 through December 2004.

The implications of downside risk methods to explain the cross-sectional variation in return with excess return was tested in emerging and developed markets (Galagedera, 2009). The information for emerging markets began from January 1993 to June 2006 and for developed markets from January 1970 to June 2006. The study utilized both downsides based risk beta and downside co-skewness as methods of downside risk. The findings of the study recommend that, in developed markets, neither the proxies of the downside is superior to conventional CAPM beta. On the other hand, in emerging stock markets, downside co-skewness elucidate stock returns superior to either downside risk based beta or CAPM beta. In this way, downside co-skewness and downside risk based beta are both utilized as proportions of downside risk in this study. The empirical results contrast from past studies in putting together downside skewness to the proportion of deliberate co-skewness risk proposed by Ang et al (2006). Instead of the proportion of deliberate co-skewness chance proposed by Kraus and Litzenberger (1976) in past empirical studies.

Mohanty, (2019) the available opportunities in the capital markets verge the investors to get the benefits of time-varying and dimensional return anomalies to optimize the return on investment. The study findings linked return variations with the market factor anomalies, factor or dimensional beta based on various multifactor models: Carhart four factors; Fama & French three factors & five factors and Asness, Frazzini and Pederson five & six factors model across twenty-two developed and twenty-one emerging stock markets. The results reveal the statistically significant variation in relating the stock returns to the sources of risk from 1997 to 2016. Each of the selected stock market exhibit variant characteristics in terms of the factor risk premium and market risk premium.

Huang & Hueng, (2008) reports a statistically significant and negative association between risk and return in downside stock market. In a recent study, Gregory, (2011) demonstrate the risk-return dynamics based on stock market risk premium under the prevailing normal market conditions relative to downside market. Alles & Murray, (2017) and Galsband, (2012) in the context of emerging stock markets report the stock return sensitivities to downside shocks over the selected period of studies across selected stocks. Moreover, Min & Kim, (2016) and Giglio, Kelly, & Pruitt, (2016) in their empirical studies proposed the incorporation of downside risk in macroeconomic variables in asset pricing.

Su, Mo, & Yin, (2020) examine the downside market volatilities in the oil markets and its impact on the underlying stock returns. Using both the static and dynamic panel modelling with industry affects the results reveal the statistically positive impact of the down risk in the oil markets on the anticipated stock returns that largely prevail across all the selected industries with nonlinearity effect. In a similar study, Reboredo, Rivera-Castro, & Ugolini, (2016) examine both upside and downside spillovers in the exchange rate and stock return in either way for the emerging markets. Based on the copulas and both upside and downside value at risk and conditional value at risk methods, the findings report the positive association between stock returns and currency values for the emerging markets.

In the groundwork of empirical literature on downside risk, it is worth mention to include downside risk in asset pricing. The prior studies largely supported the use of downside risk and various downside risk measures, such as semivariance and semivariance rather than conventional variance-based beta in single-factor models like CAPM. Based on the empirical support for single factor assert pricing models, the use of downside risk and its various measures for asset pricing in the framework of multifactor asset pricing model like APT is considered to be a valuable contribution in both theoretical and empirical research.

The above mention literature indicates the two key points related to asset pricing studies. First, these studies deliberated various factor-betas in the

APT framework based on conventional risk measures of variance, standard deviation and covariance in their traditional format. Second, the majority study findings reported that the asset and portfolios were influenced by the number of economic, financial and other factors that directly influence the pricing and valuation of these assets and portfolios. Based on the empirical literature, various methods are suggested for the selection and extraction of economic, financial and other global factors. This study adopted the Chen et al. (1986) methodology of pre-specified or observed variables covering the economic, financial and global shocks.

Augmented DR-APT Model

The augmented form of the APT model based on the convention of downside risk named as DR-APT is empirically and statically elucidated in this section. The augmented model is based on the new measures of downside risk in place of traditional risk methods. This study further extends this notion to model factors specific betas and consider the use of downside risk based betas to substitute the traditional factors betas. This extended and augmented model is called DR-APT and is mathematically expressed as follows:

$$R_{it} = E(R_{it}) + [\bar{\delta}_{i1} - R_f]b_{i1}^{d} + \ldots\ldots + [\bar{\delta}_{kt} - R_f]b_{ik}^{d} + \mu_{it}, \qquad i = 1, \ldots\ldots, N$$

The terms in the equation given above for DR-APT model, $E(R_{it}), R_{it}, \bar{\delta}_{kt}, R_f$ and b_{it}^{d} represents the ex-ante anticipated return of ith security or asset. The return on stock I in time t, the expected return on stock or portfolio with unit sensitivity to the kth factor and zero sensitivity to all other factors or the kth factor. The symbol $(\mu_{it}) = 0$ $E(\delta_{kt}\mu_{it}) = 0$, and $E(\mu_{it}\mu_{it}) = 0$ when i≠j or σ^2 when I=j, the risk-free rate, and the sensitivity of lower returns than the mean return on the ith asset or security to the kth factor (downside risk proxy based on semi-variance and semi-covariance). In this research study, we used and apply the new dynamic measurement method downside beta as the coefficient of various economic factors in pricing assets under DR-APT model. More specifically downside beta represented by b_{ik}^{d} is calculated through this equation;

$$b_{ik}^{d} = \frac{SEMICOV(R_i, \delta_k)}{SEMIVAR(\delta_{k)}}$$

$$= \frac{E\{Min[(R_i - \mu_i), 0] \times min[(R_k - \mu_k), 0]\}}{E\{Min[(R_k - \mu_k), 0]^2\}}$$

b_{it}^{d} represents the downside risk based beta
$SEMICOV(R_i, \delta_k)$ denotes the semicovariacne between asset I and market benchmark index
$SEMIVAR(\delta_{k)}$ represents the semivariance of a market benchmark index

The DR-APT equation given above postulates about the forecasting error of the security returns based on K-factors, that is communal to all the selected stocks ($\bar{\delta}_k - R_f$). Similar is the case with the idiosyncratic term (μ) specific to stock i. Accordingly, (Ross 1976) model states about the equilibrium projected return of a stock i linearly associated with various factors loading b^d expressed in the equation given below:

$$(ER_{it}) = \lambda_0 + [\lambda_1 - \lambda_0] b_{i1}^d + \ldots\ldots\ldots\ldots + [\lambda_k - \lambda_0]\, b_{ik}^d$$

The symbol λ_0 and λ_k denote the return of the risk-free security (R_f) and the variation in the market price for k^{th} factor. The equation above is the representation of the DR-APT model that explicates the relationship between the security return and downside risk premia related to the three systematic risk factors in the economy. In the case of CAPM related model based on downside risk, k = 1 is the description of security return as the linear functions of the asset downside betas in DCAPM models (Estrada, 2002). The DR-APT in its empirical implications provides several advantages, first, this model is testable and can assimilate non-linear restrictions on the cross model equation of the linear factor asset pricing model. In this situation the value of the risk of the i^{th} factor considered to be similar for all the selected securities. Second, these pricing restrictions posits the essential conditions for testing the empirical validity of the DR-APT model. Finally, the conditions imposed also permit one to test the robustness of the model at various times and across samples.

Research Methodology

This research study aims to empirically test the new augmented model of multifactor asset pricing based on downside risk (DR-APT) on Pakistan. The panel regression based on time series data of 199 stocks listed on Pakistan Stock Exchange (PSX) was tested. Stock returns dependent variable and seven economic, financial and global factors independent variables every month from 1997 to 2017 was used to test the DR-APT model. The reason to test the relationship between the various economic, financial and global factors and stock returns is to study the implications of factors shocks reflected in stock prices. The stock prices emulate the risk spawned by the economic, financial and global factors.

In the DR-APT model, the dependent variable month-wise asset returns greater than the risk-free rate of return is measured as [Min (R_i - R_f, 0)]. The security returns are the dividend-adjusted returns based on the end of the month adjusted closing prices. The independent variables are the combination of economic, financial and global predetermined factors. The factors include inflation represented by the consumer price index (CPI), industrial production index (IPI), lending interest rate, exchange rate, exports, oil prices and benchmark index return. These factors comprising independent variables in DR-APT model are measured as [Min (R_i^f -R_f, 0)]. Based on the changing dynamics of the Pakistan economy in terms of economic, the financial and global atmosphere. It is anticipated that the capital market prices mimic the varying level of risks spawned by these economic, financial and global factors. The data of these factors and the stock returns were extracted from the DataStream, World Bank economic indicators publications and international financial statistics of IMF.

Data Analysis and Results

This section of the paper reports the empirical results of various econometric tests that corroborate whether the augmented DR-APT better able to price stock returns compare to conventional APT. The test of the relationship between security returns and economic, financial and global factors is conducted to report the implications of the augmented DR-APT model. For analyzing the number of the factors in pricing the stock returns. The study tested both the linear factors model and unrestricted linear factors models with DR-APT model pricing restrictions for 199 listed firms. To report the significance of factors in pricing stock returns and to assess the validity of both risk pricing and pricing the restrictions are tested at 5% and 10% level. The analysis instigates with the correlation test among the study variables that had a range between -0.74 and 0.91. This result could overcome the chance of autocorrelation effect in the regression test.

Table 1. *Correlation test of the study variables -Pakistan*

Variables	Stocks return	CPI	IPI	Interest Rate	Exchange Rate	Exports	Total Reserves	Market return
Stocks return	1							
CPI	-.53	1						
IPI	.59	-.38	1					
Int-Rates	.91	-.57	.81	1				
Ex-Rate	-.21	.01	-.48	-.29	1			
Exports	.26	-.39	.56	.47	.64	1		
Total Reserves	.39	-.46	.27	-.42	-.22	.55	1	
Market return	.33	-.41	.71	.59	-.04	.59	.47	1

The table illustrates the output of the serial correlation test of the study variables to examine whether these variables stand independent from each other in case of PSX. The stock returns are the individual selected firm stock returns with dividend adjustment. The CPI is the monthly consumer price index representing inflation computed as the proportionate change in the cost to the consumer of purchasing a basket of goods and services. The IPI is the industrial production index that measures the monetary value of industrial output every month. For the raw volume of output produced by the various industries computed mainly as fisher indexes with the base year weight. Interest rates are the monthly lending interest rates charged by the commercial banks against loans. The exchange rate is the rate of Pakistani Rupee computed against the US dollar every month. Exports are the value of goods and services measured in million US dollars sold and delivered to various countries every month. Oil prices are the per barrel price of crude oil measured in US dollars monthly. The market return is the monthly return of the benchmark KSE-100 index.

Table 2. *Fixed and random effects model results*

Tests	Statistic	df	Prob.
Redundant fixed effects test			
Cross-section (*F*)	258.34	(21,946,428)	.000*
Cross-section (Chi-Square)	35,109.12	199	.000*
Correlated random effects-Hausman test			
Cross-section (random)	.000	7	1.000

*Significant at 1%

The table-2 shows the results of both the fixed and random effects test in time series regression for the period of 1997-2017. To see whether the random effect or fixed effect is more suitable for the given context. The cross-section, χ^2 and F assessed the mutual implication of the cross-section effect using (F-test) and the (χ^2) tests at the given significance level. The results reject the adoption of random effects model and support the adoption of a fixed-effects model in this study.

Table 3. *Factor Significance in DR-APT Model*

Factors	F-statistic	Likelihood ratio	Prob. (χ2)
CPI	94.0056	95.0127	.0000
IPI	115.0784	117.0918	.0000
Interest rates	57.8723	57.9813	.0000
Exchange rate	476.3219	474.9714	.0000
Exports	19.8729	19.9888	.0017
Oil prices	15.0918	15.1415	.0013
Market return	13739.78	13109.34	.0000
D-APT pricing restrictions	χ2 (1,49,433) = 1.08		

To estimate the augmented DR-APT model based on the various factors for pricing stock returns. The study estimates the downside risk price in combination with the likelihood ratio test for the DR-APT pricing limits reported in the table-3. The results corroborate that the study could not reject the null hypothesis that indicates the cross-sectional limits embrace correct at 5% significance level. This means that the new augmented DR-APT model provides the reasonable explication of the return performance of the stocks traded on the Pakistan stock exchange. The findings further indicate that the stock returns is explained by the significant downside risk premium of the seven different factors. All these pricing factors are substantively significant in pricing the security returns in the emerging market of Pakistan at 1% and 5% significance level.

Table 4. *Panel unit root test (DR-APT Model variables)*

Variables	Breitung Statistic	T-stat. Prob.	Lm, Pesaran & Shin Statistic	W-stat. Prob.	ADF-Fisher Statistic	χ2 Prob.
Stocks return	-39.3498	.0000	-23.0417	.0000	1167.091	.000
CPI	-28.1834	.0000	-23.1498	.0000	1090.189	.000
IPI	-23.0198	.0000	-9.8019	.0000	473.1873	.000
Interest rates	-21.0917	.0000	-10.8217	.0000	589.1047	.000
Exchange rate	-19.1347	.0000	-4.9814	.0000	385.1877	.030
Exports	-13.1872	.0000	-4.9867	.0000	329.1087	.041
Oil prices	-16.0234	.0000	-6.1235	.0000	378.1766	.015
Market return	-47.2341	.0000	-25.1908	.0000	1437.671	.000

Results in table-4 are reports the stationarity test of the study variables in the Pakistani market at 1% and 5% level. To investigate the stationarity of the time series the study used three different unit root tests including, Breitung T-stat, Lm, Pesaren and shin test, and ADF Fisher χ^2. These tests and other tests also follow that's the distribution is asymptotic normal. The findings indicate that all selected variables used and tested in the augmented DR-APT models are stationary.

Table 5. *Coefficients of the factor's downside betas of the DR-APT Model (Est.)*

Statistic	Const	CPI	IPI	Interest rate	Ex. rate	Exports	Oil prices	Market return
Coefficient	0.26773	0.0063	0.1709	0.0210	0.02982	0.0102	0.01864	0.8017
t-statistic	7.71844	4.0981	8.9395	2.9967	3.01204	1.4105	1.9971	129.09
p-value	0.0000	0.0000	0.0000	0.0028	0.0018	0.1213	0.0443	0.0000
R-square	0.8356							
Ad-R-square	0.8129							
Obs	47079							

Table-5 displays the results of panel regression based on the data of 199 listed stocks of PSX from 1997 to 2017. The findings of the seven factors DR-APT model corroborate that the increase in inflation, industrial production, interest rate, exchange rates, exports, oil prices and benchmark return upsurge the stock returns. In terms of the magnitude of impact, the market return, industrial production, inflation, exchange rate, interest rate, oil prices and exports in this sequence have the substantial impact on the returns of Pakistan capital market. The reported p-values in the table show that the relationships between various independent variables except for exports and dependent variable stock returns are significant at 5% level.

Table 6. *Results of the factors semivariance, risk premium, downside risk and its price*

Factors	Factors semi-variance	Risk premium	Factors downside betas	Price of downside risk
CPI	5.1908	-3.0413	1.7923	-0.5859
IPI	1.9723	-1.2919	1.3817	-0.6550
Interest rates	15.1872	-5.1345	4.8719	-0.3381
Exchange rate	16.1356	-5.0987	5.1214	-0.3160
Exports	7.1898	-1.9343	1.8917	-0.2690
Oil prices	5.0817	-1.9889	1.7151	-0.3914
Market return	.2195	-.3918	.5018	-1.7850
Average	7.2824	-2.6973	2.4680	-.6201

The results table-6 present the calculation and measurement of semivariance, risk premium and downside betas for the selected factors and relationship between risk and price. The earlier research studies on asset pricing indicate that the risk premium is driven by the number of financial and economic variables (Lii, 1998; Azeez & Yonezwa, 2006). This study based its finding on the relationship of factors semivariance and downside risk premia with the restrictive instabilities of economic, financial and global risk factors.

Discussion and Conclusion

The study findings indicate the significant relationship between the semivariance risk measure, downside risk beta and the worth of the downside risk of the seven independent variables. The increase in the semivariance of the respective factor brings an increase in the downside risk beta and ultimately the rise in the price of the downside risk. The rise in factors semivariance cause decline in the downside risk premium for each of the economic, financial and global risk factor. Due to this condition, both of the measures the downside risk price and factors downside betas get increase as a result of increase factors semivariance throughout the study period. In this study, the downside risk is measured as, $\lambda_i = Min\ [E(R_i) - R_f]$, here R_i denotes a factor return. Keeping aside the correlation of the factors, the downside risk price captures, $\lambda_i = \theta\sigma_S^2(\delta_i)$, the symbol θ denotes the price of the downside risk based on the investor's preferences for risk and the expression $\sigma_S^2(\delta_i)$ measures the semivariance of the economic, financial and global risk factors reported in Table five.

The results of the study are in corroboration with earlier studies that incorporate downside risk factor in the asset pricing model. Estrada (2002, 2005 and 2007), Post and Vilet (2004), Ang, Xing and Chen (2006), Javid and Ahmad (2011), Foong and Goh (2012), Tahir et al. (2013) and Rashid and Hamid (2015) reports the stocks that plunge with downward volatility should be compensated for bearing downside risk should be priced accordingly. The results reveal that the investor exposed to downside volatility earns an extra positive return in upturns period, but they confront excess losses in downturn periods studies revealed in Galagedera and Brooks (2007). The values of the downside risk premium and downside betas stipulate the exposure to downside risk and are priced on the PSX reported. The downside risk methods of semivariance and semi-deviation are proved to be more plausible measures of risk for pricing returns concerning excess returns also reported by Galagedera (2009), Estrada (2002, 2004) in CAPM related models. In terms of the explanatory power of the model, results reveal that the DR-APT models are superior model compare to conventional APT consistent with (Estrada & Serra, 2005, Estrada, 2002 & Estrada, 2007) DCAPM is superior to CAPM.

In this study, the conventional APT model is amended with augmented downside risk factors to form a new model named DR-APT for pricing stock returns in PSX. The study in its first stance smears various economic, financial and global factors affecting asset returns and as the ultimate source of idiosyncratic risk. In the second stance, the various economic, financial and global factors with their downside betas are tested against asset returns to see whether these risk factors are better able to value the stock returns.

The results of the study spectacle the pricing based limits of the augmented DR-APT model could not be precluded in the case of unconditional linear factors model. As reported, six out of seven risk factors significantly explained the stock returns and are adequate to price it in the DR-APT model. The findings of all statistical tests confirm the DR-APT as valid and better multi-factor asset pricing model. Over the entire sample period of the study, the DR-APT model performs well and empirically support the downside risk-based pricing mechanism of asset pricing theory. Similarly, the findings of the robustness control model also indorse the application of the DR-APT model for pricing stock returns. All of the study variables except exports are statistically significant over the targeted period.

Implications and Future Research Directions

The results of the study have implications for asset pricing, portfolio construction, valuations and cost of equity calculations for capital budgeting decisions. Specifically, the findings of the study are of useful interest to the investors on PSX for formulating investment strategies. Explicitly, the outcomes benefit the investors to figure out the suitable measure of risk under given conditions and to construct an optimal portfolio. For the fund and firm managers to conduct cost of equity calculations in the capital investment decisions under adverse situations. The outcomes of the study reveal that the risk-return relationship based on mean-variance hypothesis is negative and this mechanism is not appropriate for assessing the risk of securities on PSX. Compare to the conventional mean-variance hypothesis (MVH) and mean semivariance hypothesis (MSH) outperform in quantifying the risk premium of factors driving the stock returns.

In terms of limitations, it would be more productive to explain the autocorrelation between the various independent variables of the DR-APT model. To divide the time frame into the crises and non-crises period to enhance the explanatory power of the model.

Forthcoming research studies can extend the DR-APT augmented model on the emerging and developed markets in comparative terms. The most import thing to ponder is the extraction of factors that potential studies must accurately need to consider through some statistical method. Similarly, for downside risk measures, the future studies should consider other alternative methods of drawdown risk, VaR, and expected shortfall (ES) implied beta to measure downside risk for asset pricing.

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