Determinants of systematic risk in the Iranian Financial sector

Ali Askarinejad Amir[1]
Mohammad E. FadaeiNejad[2]

Abstract:

In this research, we use jump beta and continuous beta as indicators of financial sector companies systematic risk and study their determinants in banking, insurance and investment industry. In result, the value of jump beta is higher than continuous beta. Jump beta of Banking industry and Investment industry is considerably lower than average. We found some negative and positive effects of firm characteristics on jump beta and continuous beta. In insurance companies, the supremacy of jump beta is influenced by firm characteristics. Size has positive effect on aggressiveness of both continuous and jump betas in investment companies. Current ratio has positive effect and debt ratio has negative effect on aggressiveness of insurance companies. Firm characteristic has some positive and negative effects on continuous industry beta deviation, but no effect on jumpy one. Inflation has negative effect on continuous beta but has no considerable effect on jump beta. Inversely, exchange rate has negative effect on jump beta but has no sensible effect on continuous beta. Influence of growth rate is strong positive for all industries of financial sector but weak positive for banking and insurance companies.

Key words: *systematic risk, jump beta, CAPM, high frequency data, financial sector*

---

[1] PhD of Finance, Shahid Beheshti University, Tehran, Iran, Ali.Ask.Amiri@gmail.com

[2] Associate professor in Finance, Shahid Beheshti University, Tehran, Iran, m_fadaei@sbu.ac.ir.

1- Introduction

The concept of risk has been reviewed and rebuilt over periods of the development of financial theory. The CAPM model plays an important role in redefining the concept of risk and its decomposition into two components of systematic and non-systematic. Importantly, within this modeling framework, only non-diversifiable risk, as measured by the factor loading(s) [or the sensitivity to the systematic risk factor(s)], should be priced, or carry a risk premium. In other words, the risk of an investment is typically divided into two parts: idiosyncratic risk and systematic risk. Within CAPM [introduced by Sharpe (1964) and Lintner (1965)], as the most popular factor model, co-movement of returns of an individual asset (or portfolio) and the market is quantified and supposed as a systematic risk and the remaining movements of asset's return is considered as idiosyncratic risk.

Consequently, the CAPM model opens the way for the development of concepts and tools by factor models or equilibrium pricing models. The application of these models has been steadily rising over time in various areas, such as calculating capital costs, portfolio management, risk management, pricing of companies and other assets, and even pricing services. The CAPM beta is commonly used as a systematic risk indicator in most studies (Abell & Krueger, 1989), beta is named as the traditional indicator of systematic risk.

Considering the price process nature is important for return movements and pricing modelling. Brownian motion has been considered as an assumption for price movements in some financial theories like Black & Scholes option pricing model (Black & Scholes, 1973) and Merton's jump diffusion model (Merton, 1976). So, the price process is known to be the combination of continuous and jump components. Decomposing the price process into a continuous and jump component is consistent with recent evidences, e.g. Andersen, Bollerslev, and Diebold (2007), Dungey, McKenzie, and Smith (2009) and Aït-Sahalia and Jacod (2012). There is an emerging literature hypothesizing that the CAPM beta may defer for the jump and continuous components of the return, initiated by Todorov and Bollerslev (2010) and extended by Patton and Verardo (2012) and Alexeev, Dungey, and Yao (2017).

This paper takes the approach of decomposing the price process (and consequently decomposing return and beta) into a continuous and jump component. So given that asset prices evolve as a combination of Brownian motion with stochastic volatility and a jump process, we examine existence and differences between betas calculated for the continuous and jump components of systematic risk. Unlike the betas routinely calculated for Fama-French factors and other famous factor models, our continuous and jump risk betas have the same scale and are comparable.

Moreover, time-varying beta for individual firms or industries (see (Henkel, Martin, & Nardari, 2011), (Chiarella, Dieci, & He, 2013), (Reeves & Wu, 2013)) and using high-frequency data to construct beta estimation (see (Noureldin, Shephard, & Sheppard, 2012), (Todorov & Bollerslev, 2010), (Patton & Verardo, 2012)) are two other strands of research which are applied in our research approach.

The application in emerging market equities is novel; there is little literature on the high frequency behavior of emerging markets. These few cases are in Chinese markets (Liao, Anderson, & Vahid, 2010; Zhou & Zhu, 2012), in Eastern European markets (Hanousek & Novotný, 2012) and on the stocks of financial sector in India (Sayed, Dungey, & Yao, 2015), while the emerging markets are critically important to the future of the world economy. Amiri and FadaeiNejad (2017) studied the efficiency of jump beta approach in Iran capital market. In addition to model efficiency, they found greater significance of jump beta, greater value of jump beta and greater jumpy risk premium. Its worthy to note that, in addition to empirical studies, after (Todorov & Bollerslev, 2010) which design and prove the model using mathematical assumptions and theorems, (Alexeev et al., 2017) studied the model efficiency using simulation.

2- Theoretical framework and literature review

2-1-Jump-continuous risk model

One factor model may be represented as below:

$$r_i = \alpha_i + \beta_i r_0 + \epsilon_i \ , \quad i = 1, \dots, N \qquad (1)$$

Where:

r_i = returns on the *i-th* asset,

r_0 = returns on the systematic risk factor,

β_i = the *i-th* asset's return sensitivity to systematic risk factor,

ϵ_i = the idiosyncratic risk (assumed to be uncorrelated with r_0).

The most popular one-factor model is obviously CAPM in which the beta is proportional to the covariation of the asset with respect to the aggregate market portfolio. In the case r_0 is notated as r_m.

The beta of an asset is not directly observable and should be estimated. The traditional way of estimating betas relies on rolling linear regression, typically based on five years of monthly data, as estimated in the classical studies by Fama and MacBeth (1973) and Fama and French (1992). But recently, availability of high-frequency financial prices has encouraged to alternative ways for more accurately estimating betas. In particular, Andersen, Bollerslev, Diebold, and Wu (2005,2006), Bollerslev, Law, and Tauchen (2008) and Barndorff-Nielsen and Shephard (2004) among others, have all explored new procedures for measuring and forecasting period-by-period betas based on so-called realized variation measures. These measures constructed from calculation of higher frequency data within period (especially intraday) returns. Such studies generally confirm that the use of high-frequency data results in statistically far superior beta estimates relative to the traditional regression based procedures.

Another stream of recent literature is concerned with possibility of price discontinuities (jumps), e.g. (Andersen et al., 2007), (Barndorff-Nielsen & Shephard, 2006), (Huang & Tauchen, 2005), (Mancini, 2009), (Lee & Mykland, 2008) and (Aït-Sahalia & Jacod, 2009). In result of such researches, it appears that the market rewards severe price moves differently from smooth price variation. Consequently, we may expect different risk premium for two different types of price variation, while most existing pricing models neglect this probable differentiation.

Combining the above ideas and empirical observations obviously suggests decomposing the return within the linear factor model framework into the returns associated with continuous price moves (r_{m}^{c}) and discontinuous price moves (r_{m}^{d}). So, the one-factor model is described by Todorov and Bollerslev (2010) as:

$$r_i = \alpha_i + \beta_i^c r_{\mathrm{m}}^c + \beta_i^d r_{\mathrm{m}}^d + \epsilon_i \quad . \quad i = 1. \dots . N \qquad (2)$$

Where by definition $r_{\mathrm{m}} = r_{\mathrm{m}}^c + r_{\mathrm{m}}^d$ and two separate betas represent the systematic risks attributable to each of the two return components. Using Eq. (2), we can attribute the overall systematic risk to either the continuous component r_{m}^c , or the discontinuous component r_{m}^d. Recognition of this, is important as the implication that $\beta_{\mathrm{m}}^c = \beta_{\mathrm{m}}^d = 1$ is critical in the identification of the β_i^c and β_i^d coefficients in (Todorov & Bollerslev, 2010).

In the case that $\beta_i^c = \beta_i^d$, the model reduces to the standard one-factor model. In other words, this kind of modeling remove the restriction of no difference assumption between continuous and discontinuous price moves and let the decomposed betas to be identified, if exist, without any restriction.

As another case, $\beta_i^d = 0$, may be assumed where jump risks for individual stocks are likely to be non-systematic and diversifiable. Observing $\beta_i^d > 0$ indirectly suggests non-zero jump sensitivities.

Patton and Verardo (2012) hypothesizes that as jumps are commonly associated with news arrival, a jump beta which exceeds continuous beta may imply that stocks update faster to unexpected. For investors, the knowledge that individual stocks respond differently to the continuous and jump components of systematic risk is likely to provide a valuable tool in managing portfolio diversification.

2-2- Determinants of systematic risk

There are many researches which studying the determinants of systematic risk regardless of specific industry. Callahan and Mohr (1989), while reviewing past studies and using mathematical relations, showed that the financial leverage and operating leverage of the company had a direct impact on its beta value. Aruna and Warokka (2013) examined the impact of corporate accounting variables such as current ratio, debt to total assets, long-term debt ratio to total assets, company size and growth on beta, and consequently no effective relationship found. Iqbal and Shah (2012) showed that liquidity, financial leverage, operating efficiency and dividend have negative effect on beta, while profitability, size, and growth have positive effect on it. Houmes, MacArthur, and Stranahan (2012) examined the effect of operating leverage on beta using panel data methods and concluded the positive effect. A significant relationship between the size, operating efficiency and profitability of companies with their beta are found in (Nawaz et al., 2017). Adhikari (2015) found that the variables of size and profitability of the company positively correlated with the beta, and dividend ratio negatively. Influence of macroeconomic variables on industry beta is another strand of research, which is studied by (Shan & Alles, 2000), (Andersen et al., 2005) and (Sadorsky, 2012).

Along with the above research, which has examined this issue in general, and without regard to the particular industry, some researches focusing on financial sector companies. di Biase and Elisabetta (2012) examined the factors affecting banks' beta and showed that bank size had a direct effect but the bank's profitability and liquidity had a reverse effect on beta. Kumar, Aleemi, and Ali (2015) studied factors affecting beta in the banking industry, it has been found that the quality of the portfolio of loans and the profitability of the bank is positive and its liquidity has a negative relation with beta and parameters such as Size, leverage, and dividend ratio have no effect on beta. Sayed et al. (2015), like our research, used jump beta approach. They observed that in the banking industry, the bank's capital reduces both jump beta and continuous beta, and leverage increasing both. In total, it can be said that there is little research on determinants of jump beta and continuous beta in the financial sector companies.

3- Methodology

3-1- Jump/continuous beta estimation

In practice, we usually observe prices and returns every Δ time interval, from 0, Δ, 2Δ, …, to [T /Δ]·Δ. Keeping Δ fixed, we denote the Δ-period return on asset *i* by:

$$r_{i.j} = p_{i.j\Delta} - p_{i.(j-1)\Delta} \quad . \quad i = 0.1. \dots . [T/\Delta] \qquad (3)$$

Using vector notation, let the (N + 1) × 1 vector of the observed returns to be:

$$r_j = (r_{0.j}.r_{1.j}. \dots \; r_{N.j})'$$

i j			Assets
			0 1 2 . . . N
Time	1 . . . T/Δ	Δ 2Δ 3Δ . . T	

The consistent estimators for β_i^c and β_i^d given by Todorov and Bollerslev (2010) are constructed as follows. We set a truncation threshold:

$$\theta = (a_0\Delta^{\omega}. a_1\Delta^{\omega}. \ldots . a_N\Delta^{\omega})'$$

Where:

$\omega \in \left(0. \frac{1}{2}\right)$

$a_i \geq 0$

$i = 0. \ldots .\ N$

We allow for different truncation thresholds across different assets by controlling a_i. Providing an intuitive interpretation, for instance, when $a_i = 3$, price increment that is larger than three standard deviations is classified as jumps. The continuous price movement corresponds to those observations that satisfy $|r_j| \leq \theta$.

Asset i	0	1	….	N
truncation threshold	θ_0	θ_1	….	θ_N
	$a_0\Delta^{\omega}$	$a_1\Delta^{\omega}$	….	$a_N\Delta^{\omega}$

The discrete-time estimator of the continuous beta, $\hat{\beta}_i^c$, is:

$$\hat{\beta}_i^c = \frac{\sum_{j=1}^{[T/\Delta]} r_{i.j} r_{\mathrm{m}.j} \mathbb{1}_{(|r_j| \leq \theta)}}{\sum_{j=1}^{[T/\Delta]} r_{\mathrm{m}.j}^2 \mathbb{1}_{(|r_j| \leq \theta)}} \quad . \quad for\ i = 1. \ldots .\ N \quad (4)$$

where $\mathbb{1}$ is the indicator function,

$$\mathbb{1}_{(|r_j| \leq \theta)} = \begin{cases} 1 & if \quad |r_j| \leq \theta \\ 0 & if \ \ otherwise \end{cases}$$

The discrete time estimator of $\hat{\beta}_i^d$ is

$$\hat{\beta}_i^d = sign\left\{\sum_{j=1}^{[T/\Delta]} sign\{r_{i.j} r_{\mathrm{m}.j}\} \left|r_{i.j} r_{0.j}\right|^{\tau}\right\} \times \left\{\frac{\sum_{j=1}^{[T/\Delta]} sign\{r_{i.j} r_{\mathrm{m}.j}\} \left|r_{i.j} r_{\mathrm{m}.j}\right|^{\tau}}{\sum_{j=1}^{[T/\Delta]} r_{\mathrm{m}.j}^{2\tau}}\right\}^{\frac{1}{\tau}} \quad (5)$$

The power τ is restricted to $\tau \geq 2$ so that the continuous price movements do not matter asymptotically (see Todorov and Bollerslev (2010), for more details). The sign in (9) is taken to recover the signs of the jump betas that are eliminated when taking absolute values. The estimator in (9) converges to β_i^d when there is at least one systematic jump (in the market portfolio) on (0, T]. Therefore, in order to calculate $\hat{\beta}_i^d$, we first need to test for the existence of jumps on the log-price series p0 of the market portfolio.

Abovementioned estimators which are introduced by (Todorov & Bollerslev, 2010) based on mathematical and statistical assumptions, theorems and proofs, studied by simulation in (Alexeev et al., 2017).

For identification of jumps, we use $\hat{\mathcal{J}}$ statistic presented by (Barndorff-Nielsen & Shephard, 2006) with below specification:

$$\hat{\mathcal{J}} = \frac{1}{\sqrt{\Delta}} . \frac{1}{\sqrt{\psi . \max(1/T . DV_{\mathrm{m}}/BV_{\mathrm{m}}^2)}} \left(\frac{\mu_1^{-2} . BV_{\mathrm{m}} - RV_{\mathrm{m}}}{RV_{\mathrm{m}}}\right) \xrightarrow{L} \mathcal{N}(0.1) \quad (6)$$

To see how calculating RV_{m} , BV_{m} and DV_{m} and value of parameters ψ , μ_1 , ω , a_i , τ you may refer to (Amiri & FadaeiNejad, 2017) or (Todorov & Bollerslev, 2010).

3-2- Data processing

Based on the nature of the study and its dependency on high-frequency data, the records of all trades in the stock market were needed. Persistent and steady attendance of stock ticker symbol in the market and high tradability were so important for stocks to be qualified for such a research. Therefore, it was possible to use 53 financial firms in the research. The firms are in three industries of banking, insurance and investment.

Table 1: sample firms classified by industry

Industry	Number of companies

Banking	20
Insurance	10
Investment	23

The main and different data of this research, which is the subject of the exploitation of big data approach, relates to the total trading data of the Tehran Stock Exchange gotten as MS SQL Server 2012 backup files from the Tehran Securities Exchange Technology Management Co. The data includes nearly 70 million transactions (69,948,927 records) for the years 2008 to 2015. Data about firm characteristics are taken from Mabna financial processing co. Which is working under supervision of Securities and Exchange Organization (SEO). Data of Macroeconomic variables are taken from databases of Central Bank of Iran.

Period of research is 7.5 year, starting in spring 2008 until summer 2015, containing 30 quarters. Return horizon (Δ) is 30 minute. It means each trading day (which is from 9:00 am to 12:30 pm) contains 7 return horizons. Beta estimation window is three months (a quarter). The window is selected since our data of macroeconomic variables and firm characteristics are available in quarterly bases. So our panel data has cross section dimension of 53 stocks and period dimension of 30 seasons. Each record of panel data (each stock-season) contain 10 field of data: 2 calculated jump and continuous beta; 5 firm characteristics; and 3 macroeconomic variables.

The first step in calculating betas are truncation threshold calculation. So, we calculate BV_i , a_i and θ_i respectively for each asset and for market index. Using θ_i as a truncation threshold for asset *i* , the return horizons which contain jumps are detected. Table 3 demonstrates calculated values and number of jump horizons for couple of assets. Recall that when calculating $\hat{\beta}_i^c$ by Eq. (8), only those observations that satisfy $|r_j| \leq \theta$ are used.

Table 2: sample calculations of truncation thresholds

	$\boldsymbol{BV_i}$	$\boldsymbol{a_i}$	$\boldsymbol{\theta_i}$	$\boldsymbol{|r_j| \geq \theta}$
Tejarat Bank	0.138118	1.114927	0.012923	579
Sina Bank	0.152377	1.171066	0.013574	559
Post Bank	0.156265	1.185911	0.013746	555
Eqtesad Novin Bank	0.131976	1.089856	0.012633	552
Ansar Bank	0.160769	1.20288	0.013943	488

Day Bank	0.171727	1.243199	0.01441	426
Parsian Bank	0.149151	1.158602	0.01343	423
Mellat Bank	0.131833	1.089263	0.012626	415
Pasargad Bank	0.128655	1.076053	0.012473	415
Hekmat Bank	0.123392	1.053816	0.012215	409
Saderat Bank	0.091548	0.907706	0.010521	404

3-3- research design

Part I. we study three forthcoming hypothesis for each industry of financial sector companies:

- Hyp1: Jump beta is greater than continuous beta in the industry.
- Hyp2: Continuous beta in the industry has no significant difference with average continuous beta.
- Hyp3: Jump beta in the industry has no significant difference with average jump beta.

Part II. We study the influence of firm characteristics on jump beta and continuous beta in each industry of financial sector. we chose 5 financial ratios as a firm characteristics: Size (logarithm of market cap), ROA (Return on Assets), ROE (Return on Equity), CR (Current Ratio), DR (Debt to equity Ratio).

Effect of firm characteristics on jump/continuous beta is studied using panel data method. Since in panel data methods, each dimension of cross-section and period may be of each states of : pooled, fixed effect model or random effect model. So executing hausman test and fixed effect model test before model specification is necessary.

Part III. We study the effect of firm characteristics on supremacy of jump beta than continuous beta in each industry of financial sector. For doing this section of research, we used probit regression which explained variable is jump beta supremacy.

Part IV. In the fourth section of the research, influence of firm characteristics on stock aggressiveness is studied for each industry of financial sector. The probit regression with stock jump/continuous aggressiveness as dependent variable is the method of this section.

Part V. In addition to industry beta, as a mean, beta dispersion or convergence in each industry of financial sector is a question. So we studied the effect of firm characteristics on industry beta deviation using probit regression.

Part VI. Effect of macroeconomic variables on jump beta and continuous beta is studied using panel data regression with below specification.

$$\beta_{it} = \alpha + \gamma_1 Inf_t + \gamma_2 Grth_t + \gamma_1 ExR_t + Control\ Variables$$

In abovementioned equation, β_{it}^{d} and β_{it}^{c} will substitute instead of β_{it}. Firm characteristics variables will be used as control variables.

4- Results

In the following, we reported the results of procedures described in previous section. Firstly, we see the results of part I in table 3. In column 2 and 3, the jump beta and continuous beta average of each financial industry along with confidence interval of 95% may be seen. In column 3 of table 3, result of testing hypothesis 1 is reported. It should be noted that in this table and other tables of this article, the *, **, and *** symbols are equivalent to 10%, 5% and 1% significance level respectively.

Table 3: Hypothesis testing about betas averages

	$\bar{\bar{\beta}}^{c}$ (95%)	$\bar{\bar{\beta}}^{d}$ (95%)	t_{Hyp1}	t_{Hyp2}	t_{Hyp3}
Banking	0.69±0.16	1.03±0.26	-4.72***	-1.29	1.64*
Insurance	0.72±0.27	1.11±0.54	-2.71***	-0.79	-0.37
Investment	0.64±0.13	0.92±0.23	-4.13***	-0.50	2.66***

The observation of the fourth column shows that in all financial industries, the amount of t-statistic is very significant. In this way, we conclude that in all of them, the value of jump beta is higher than continuous beta. Interpretation of this result suggests that, in financial sector, the sensitivity of stocks and their response to unexpected news and jumpy movements are more than their sensitivity to continuous movements of market risk factor.

The strong result of hypothesis 1 reinforce the necessity of using jump beta approach for financial sector companies. Equality of jump beta and continuous beta cause the model to decrease to CAPM model. So, the result reinforce the importance of decomposing beta to two component of jump and continuous.

Columns 4th and 5th of table 3 showed results of hypothesis 2 and 3. The result show that jump beta of Banking industry and Investment industry is considerably lower than average. Other indices of systematic risk in financial sector have no sensible difference from average of other industries. The visual description of this statistical inference may be seen it figures 1, 2, 3.

Figure 1: Comparison of banking jump/continuous betas with industries averages

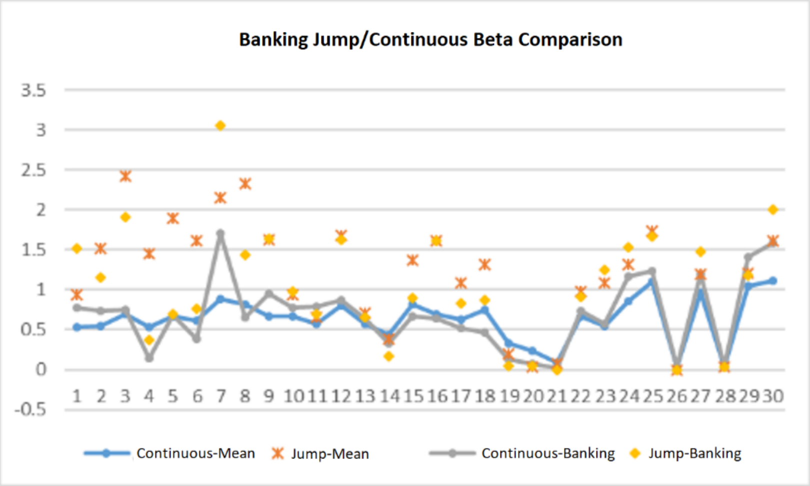


Figure 2: Comparison of Insurance jump/continuous betas with industries averages

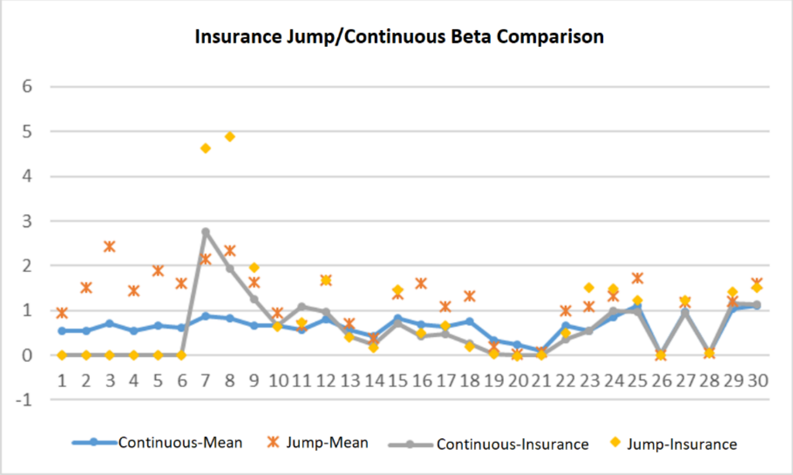
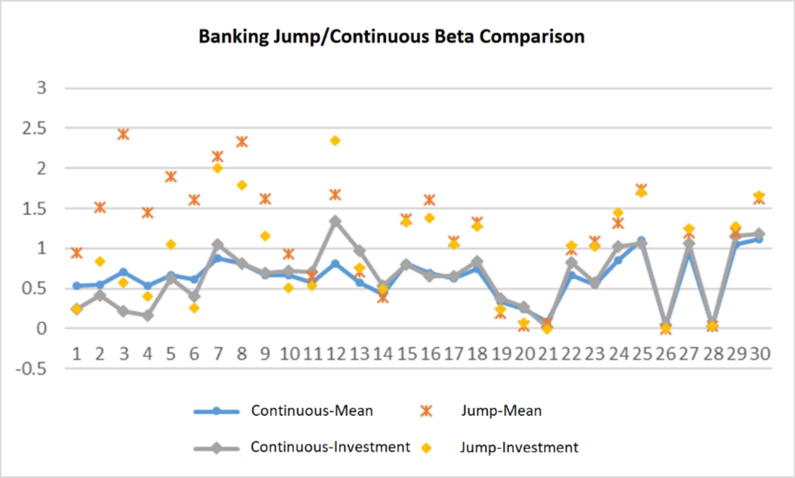


Figure 3: Comparison of Investment jump/continuous betas with industries averages



In part II of the research, we study the effect of firm characteristics on jump beta and continuous beta using panel data approach. So executing hausman test and fixed model test is necessary to decide the finest modeling about cross section and period dimension of panel data method. You may see the result of such tests in table 4 which the panel data method is based upon them.

Table 4: Hausman test and fixed effect model test results

		Fixed effect model						Random effect model	
		cross section		period		cross section & period		Cross section	period
		F	χ^2	F	χ^2	F	χ^2	χ^2	χ^2
Banking	β^c	1.55*	32.59**	13.86***	311.31***	9.78***	346.69***	25.27***	6.67
	β^d	0.30	6.62	8.45***	215.33***	5.32***	222.53***	3.87	1.67
Insurance	β^c	2.82***	29.98***	9.13***	161.92***	9.28***	200.42***	12.64**	10.48*
	β^d	0.72	8.19	6.46***	128.19***	5.63***	146.45***	9.69*	15.96***
Investment	β^c	4.83***	107.43***	11.20***	280.03***	8.38***	346.16***	7.86	6.01
	β^d	1.78**	41.96***	9.81***	251.90***	6.30***	277.71***	7.36	4.12

As may be observed in table 5, size has negative effect on continuous beta of investment companies. ROA has negative effect on continuous beta in insurance companies and investment companies. ROE has positive effect on continuous beta in insurance companies. Current ratio has no effect on betas in financial sector companies. Ratio of debt to equity has negative effect on continuous beta in insurance and investment companies and negative effect on jump beta in investment companies.

Table 5: Effect of firm characteristics on jump beta and continuous beta

		r^2	*F*	*Intercept*	*Size*	*ROA*	*ROE*	*CR*	*DR*
Banking	β^c	0.57	9.24	1.89 (1.76)	-0.05 (0.07)	-0.001 (0.01)	-0.0002 (0.001)	-0.02 (0.04)	0.0008 (0.006)
	β^d	0.41	4.96	2.45 (3.44)	-0.06 (0.15)	0.004 (0.02)	0.0003 (0.002)	-0.03 (0.08)	0.004 (0.01)
Insurance	β^c	0.72	9.24	2.15 (1.84)	-0.06 (0.08)	-0.05** (0.02)	0.005** (0.002)	0.006 (0.35)	-0.01*** (0.007)
	β^d	0.60	5.56	-4.32 (4.01)	0.22 (0.19)	-0.002 (0.05)	0.006 (0.005)	0.53 (0.77)	-0.01 (0.01)
Investment	β^c	0.47	8.24	3.24** (1.49)	-0.11* (0.06)	-0.01* (0.008)	0.006 (0.006)	-0.0007 (0.0008)	-0.24*** (0.06)
	β^d	0.38	5.92	4.06* (2.71)	-0.13 (0.12)	-0.01 (0.01)	0.008 (0.01)	-0.001 (0.001)	-0.30*** (0.11)

According to table 6, the supremacy of jump beta is influenced by firm characteristics only in insurance companies. Size and ROA have positive effect on jump beta supremacy in such companies.

Table 6: Effect of firm characteristics on jump beta supremacy

	MF	HQ	Intercept	Size	ROA	ROE	CR	DR
Banking	0.003	1.32	-0.17	0.027	0.035	-0.0004	-0.08	-0.0007
Insurance	0.07	1.32	-6.02**	0.31**	0.24**	-0.02	-0.57	0.01
Investment	0.004	1.34	-0.48	0.04	-0.002	-0.003	-0.001	-0.04

According to table 7, size has positive effect on aggressiveness of both continuous and jump betas in investment companies. Current ratio has positive effect and debt ratio has negative effect on aggressiveness of insurance companies.

Table 7: Effect of firm characteristics on stock aggressiveness

		MF	*HQ*	*Intercept*	*Size*	*ROA*	*ROE*	*CR*	*DR*
Banking	Agg_β^c	0.01	1.42	0.05	-0.005	0.04	-0.01	0.0004	0.003
	Agg_β^d	0.005	1.42	0.008	-0.01	0.02	-0.003	0.01	0.004
Insurance	Agg_β^c	0.05	1.38	-0.43	-0.03	-0.08	0.01	1.29**	-0.04**
	Agg_β^d	0.02	1.44	0.55	-0.06	0.03	0.005	0.67	-0.02
Investment	Agg_β^c	0.03	1.37	-3.58***	0.16***	-0.005	-0.001	0.002	-0.17
	Agg_β^d	0.01	1.38	-2.34***	0.10***	-0.01	0.005	-0.0001	-0.17

Determinants of industry beta deviation are showed in table 8. Size has positive effect on continuous beta deviation in investment industry. ROE has negative effect on continuous beta deviation in banking industry. Current Ration has positive effect on continuous beta deviation in insurance and investment industry. Finally debt ratio has negative effect on continuous beta deviation in insurance companies. As observed in the table, deviation from industry jump beta has no influence from firm characteristics.

Table 8: Effect of firm characteristics on industry beta deviation

		MF	*HQ*	*Intercept*	*Size*	*ROA*	*ROE*	*CR*	*DR*
Banking	β^c_dev	0.01	1.40	0.32	-0.02	0.04	-0.01*	0.03	0.006
	β^d_dev	0.005	1.43	-0.11	-0.002	0.03	-0.002	0.05	0.007
Insurance	β^c_dev	0.04	1.40	-1.12	-0.001	-0.03	0.007	1.26***	-0.03**
	β^d_dev	0.03	1.45	-3.14	0.11	0.03	0.005	0.80	-0.02
Investment	β^c_dev	0.03	1.37	-3.94***	0.18***	-0.003	-0.002	0.002*	-0.13
	β^d_dev	0.02	1.40	-2.60	0.13	-0.004	-0.006	0.002	-0.02

In the last section of the empirical research (part VI), macroeconomic variables are assumed as determinants of two components of systematic risk. Some firm characteristics are used as control variables to absorb their contribution of influence to improve the validity of results.

Table 9: Effect of macroeconomic variables on continuous beta

	r^2	*F*	*Intercept*	*Macroeconomic Variables*			*Control Variables*		
				Inflation	*Growth Rate*	*Exchange Rate*	*Size*	*ROA*	*Financial leverage*
Banking	0.15	2.83***	-4.77***	-0.008**	5.37***	-0.46	0.25***	-0.02	0.01*
Insurance	0.31	4.67***	-1.46	-0.01**	6.27***	-0.98	0.13	-0.02	-0.02**
Investment	0.19	4.66***	-3.19**	-0.01***	4.25***	-0.62*	0.20***	-0.003	-0.20***

Table 9 concentrated on relation of macroeconomic variables with continuous beta. Inflation has negative effect on continuous beta in all segments of financial sector. Growth rate has positive effect on all segments of financial sectors. While exchange rate, except weak negative effect on continuous beta of investment industry, has no sensible effect on continuous beta of financial sector.

Table 10: Effect of macroeconomic variables on jump beta

	r^2	*F*	*Intercept*	*Macroeconomic Variables*			*Control Variables*		
				Inflation	*Growth Rate*	*Exchange Rate*	*Exchange Rate*	*Size*	*ROA*
Banking	0.06	1.03	-4.60	0.0009	4.50*	-2.20***	0.26**	-002	0.01
Insurance	0.19	2.43***	-5.95	-0.006	8.82**	-3.02**	0.36*	0.04	-0.02
Investment	0.08	1.75*	-5.78**	-0.008	1.64	-2.19***	0.34***	-0.003	-0.25**

Table 10 concentrate on relation of macroeconomic variables with jump beta in financial companies. The relation is approximately inverse of their relation with continuous beta. It means the inflation influence on jump beta is totally ignorable, while the negative effect of exchange rate on jump beta is strong and considerable. The moderate positive effect of growth rate on jump beta is observed in banking and insurance industries.

5- Conclusion

Systematic risk has multiple applications in corporate finance and investment areas. CAPM beta is mostly known as an index for companies’ systematic risk. It used to be important in capital budgeting process as a main ingredient of calculation of cost of capital. Moreover, beta has great role in risk management and portfolio management processes. However, CAPM is not the only factor model used for detecting systematic risk indices of companies. In this paper we used the model introduced by Todorov and Bollerslev (2010) which assumes brownian motion as nature of price movement and subsequently decompose CAPM beta to jump beta and continuous beta. Then we supposed these two kinds of beta as indicators of systematic risk.

In the research, we studied the systematic risk of Iranian financial sector, i.e. banking, insurance and investment companies traded in TSE, and determinants of systematic risk of financial sector companies using jump beta and continuous beta.

Our empirical study show that in financial industry companies, the value of jump beta is higher than continuous beta. Jump beta of Banking industry and Investment industry is considerably lower than average. However, Other indices of systematic risk in financial sector have no sensible difference from average of other industries. We found some negative and positive effects of firm characteristics on jump beta and continuous beta. However, only in insurance companies, the supremacy of jump beta is influenced by firm characteristics.

Studying stock aggressiveness, size has positive effect on aggressiveness of both continuous and jump betas in investment companies. Current ratio has positive effect and debt ratio has negative effect on aggressiveness of insurance companies. Studying industry beta deviation, firm characteristic has some positive and negative effects on continuous industry beta deviation, but deviation from industry jump beta has no influence from firm characteristics.

Inflation, growth rate and foreign exchange rate are considered as macroeconomics variables may effecting systematic risk of financial sector companies. Inflation has negative effect on continuous beta but has no considerable effect on jump beta. Inversely, exchange rate has negative effect on jump beta but has no sensible effect on continuous beta. Influence of growth rate is strong positive for all industries of financial sector but weak positive for banking and insurance companies.

6- References

Abell, J. D., & Krueger, T. M. (1989). Macroeconomic influences on beta. *Journal of Economics and Business, 41*(2), 185-193.

Adhikari, N. (2015). Determinants of Systemic Risk for Companies Listed on Nepal Stock Exchange. *Global Journal of Management And Business Research, 15*(5).

Aït-Sahalia, Y., & Jacod, J. (2009). Testing for jumps in a discretely observed process. *The Annals of Statistics,* 184-222.

Aït-Sahalia, Y., & Jacod, J. (2012). Analyzing the spectrum of asset returns: Jump and volatility components in high frequency data. *Journal of Economic Literature, 50*(4), 1007-1050.

Alexeev, V., Dungey, M., & Yao, W. (2017). Time-varying continuous and jump betas: The role of firm characteristics and periods of stress. *Journal of Empirical Finance, 40,* 1-19.

Amiri, A. A., & FadaeiNejad, M. E. (2017). *Time-varying modelling of systematic risk: using high-frequency characterization of Tehran stock exchange*. Working Paper. International Journal of Finance and Managerial Accounting.

Andersen, T. G., Bollerslev, T., & Diebold, F. X. (2007). Roughing it up: Including jump components in the measurement, modeling, and forecasting of return volatility. *The Review of Economics and Statistics, 89*(4), 701-720.

Andersen, T. G., Bollerslev, T., Diebold, F. X., & Wu, G. (2006). Realized beta: Persistence and predictability *Econometric Analysis of Financial and Economic Time Series* (pp. 1-39): Emerald Group Publishing Limited.

Andersen, T. G., Bollerslev, T., Diebold, F. X., & Wu, J. G. (2005). *A framework for exploring the macroeconomic determinants of systematic risk*. Retrieved from

Aruna, D. C., & Warokka, A. (2013). Systematic risk and accounting determinants: a new perspective from an emerging market. *Journal for Global Business Advancement, 6*(1), 24-37.

Barndorff-Nielsen, O. E., & Shephard, N. (2006). Econometrics of testing for jumps in financial economics using bipower variation. *Journal of financial Econometrics, 4*(1), 1-30.

Barndorff-Nielsen, O. E., & Shephard, N. (2004). Econometric analysis of realized covariation: High frequency based covariance, regression, and correlation in financial economics. *Econometrica, 72*(3), 885-925.

Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of political Economy, 81*(3), 637-654.

Bollerslev, T., Law, T. H., & Tauchen, G. (2008). Risk, jumps, and diversification. *Journal of Econometrics, 144*(1), 234-256.

Callahan, C. M., & Mohr, R. M. (1989). The Determinants of Systematic Risk: A Synthesis. *Financial Review, 24*(2), 157-181.

Chiarella, C., Dieci, R., & He, X.-Z. (2013). Time-varying beta: a boundedly rational equilibrium approach. *Journal of Evolutionary Economics, 23*(3), 609-639.

di Biase, P., & Elisabetta, D. A. (2012). The determinants of systematic risk in the Italian banking system: A cross-sectional time series analysis. *International Journal of Economics and Finance, 4*(11), 152.

Dungey, M., McKenzie, M., & Smith, L. V. (2009). Empirical evidence on jumps in the term structure of the US Treasury market. *Journal of Empirical Finance, 16*(3), 430-445.

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance, 47*(2), 427-465.

Fama, E. F., & MacBeth, J. D. (1973). Risk, return, and equilibrium: Empirical tests. *Journal of political Economy, 81*(3), 607-636.

Hanousek, J., & Novotný, J. (2012). Price jumps in Visegrad-country stock markets: An empirical analysis. *Emerging Markets Review, 13*(2), 184-201.

Henkel, S. J., Martin, J. S., & Nardari, F. (2011). Time-varying short-horizon predictability. *Journal of financial economics, 99*(3), 560-580.

Houmes, R. E., MacArthur, J. B., & Stranahan, H. (2012). The operating leverage impact on systematic risk within a context of choice: an analysis of the US trucking industry. *Managerial Finance, 38*(12), 1184-1202.

Huang, X., & Tauchen, G. (2005). The relative contribution of jumps to total price variance. *Journal of financial Econometrics, 3*(4), 456-499.

Iqbal, M. J., & Shah, S. Z. A. (2012). Determinants of systematic risk. *The Journal of Commerce, 4*(1), 47-56.

Kumar, V., Aleemi, A. R., & Ali, A. (2015). The Determinants of Systematic Risk: Empirical Evidence From Pakistan's Banking Sector. *Global Management Journal for Academic & Corporate Studies, 5*(1), 146.

Lee, S. S., & Mykland, P. A. (2008). Jumps in financial markets: A new nonparametric test and jump dynamics. *Review of Financial Studies, 21*(6), 2535-2563.

Liao, Y., Anderson, H. M., & Vahid, F. (2010). *Do Jumps Matter?: Forecasting Multivariate Realized Volatility Allowing for Common Jumps*: Australian National University,[College of Business & Economics].

Lintner, J. (1965). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *The Review of Economics and Statistics, 47*(1), 13-37.

Mancini, C. (2009). Non-parametric Threshold Estimation for Models with Stochastic Diffusion Coefficient and Jumps. *Scandinavian Journal of Statistics, 36*(2), 270-296.

Merton, R. C. (1976). Option pricing when underlying stock returns are discontinuous. *Journal of financial economics, 3*(1-2), 125-144.

Nawaz, R., Ahmed, W., Imran, S. S., Arshad, M., Rani, T., & Khan, A. (2017). Financial Variables and Systematic Risk. *Chinese Business Review, 16*(1), 36-46.

Noureldin, D., Shephard, N., & Sheppard, K. (2012). Multivariate high-frequency-based volatility (HEAVY) models. *Journal of Applied Econometrics, 27*(6), 907-933.

Patton, A. J., & Verardo, M. (2012). Does beta move with news? Firm-specific information flows and learning about profitability. *Review of Financial Studies, 25*(9), 2789-2839.

Reeves, J. J., & Wu, H. (2013). Constant versus Time-Varying Beta Models: Further Forecast Evaluation. *Journal of Forecasting, 32*(3), 256-266.

Sadorsky, P. (2012). Modeling renewable energy company risk. *Energy Policy, 40*, 39-48.

Sayed, M., Dungey, M., & Yao, W. (2015). High frequency characterization of Indian banking stocks.

Shan, W. C., & Alles, L. (2000). The Sensitivity of Australian Industry Betas to Macroeconomic Factors.

Sharpe, W. F. (1964). CAPITAL ASSET PRICES: A THEORY OF MARKET EQUILIBRIUM UNDER CONDITIONS OF RISK*. *The Journal of Finance, 19*(3), 425-442.

Todorov, V., & Bollerslev, T. (2010). Jumps and betas: A new framework for disentangling and estimating systematic risks. *157*(2), 220-235.

Zhou, H., & Zhu, J. Q. (2012). An empirical examination of jump risk in asset pricing and volatility forecasting in China's equity and bond markets. *Pacific-Basin Finance Journal, 20*(5), 857-880.