AN ASSESSMENT OF SYSTEMATIC RISK: EVIDENCE FROM EMERGING MARKETS

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ABSTRACT

Despite the popularity and simplicity of CAPM, many studies have been carried out to test the validity of the beta coefficient as a measurement of systematic risk. Various studies have focused on testing the stationarity of beta and its explanatory power, and have demonstrated that beta is not an effective measurement of systematic risk.

This paper aimed at providing a comprehensive examination of beta stationarity for the entire set of emerging markets. The data for all 20 emerging countries (as listed by Thompson Datastream) were used in this study. In order to investigate whether other factors could alleviate the stationarity issue, the beta coefficient calculated with the single index model was compared with those calculated with multi-index model, namely the Fama French three-factor model and a combination multi-index model and a single index model; this was through an integrated method.

There were four key findings from this study. Firstly, the results clearly showed that Vasicek's Bayesian approach improved the prediction power of single index model betas for emerging markets. Secondly, Blume's regression approach did not improve the prediction power of betas. Thirdly, the Fama French model did not proxy the risk of emerging markets. Lastly, the results also suggest that integrated methods work over short periods only.

KEY WORDS: BETA STATIONARITY / EMERGING MARKETS / SINGLE INDEX MODEL / MULTI-INDEX MODEL / ADJUSTED BETA

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การศึกษาความเสี่ยงที่เป็นระบบ (SYSTEMATIC RISK): ข้อมูลหลักฐานจากตลาดเกิดใหม่
AN ASSESSMENT OF SYSTEMATIC RISK: EVIDENCE FROM EMERGING MARKETS

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บทคัดย่อ

แม้ว่าแบบจำลองการตั้งราคาทรัพย์สินประเภททุน (CAPM) จะเป็นที่เข้าใจง่ายและได้รับความนิยมในกลุ่มนักลงทุน แต่ก็มีงานวิจัยจำนวนมากที่พยายามทดสอบความถูกต้องในการวัดความเสี่ยงที่เป็นระบบด้วยค่าสัมประสิทธิ์ความชันของหลักทรัพย์ (beta coefficient) ของแบบจำลองดังกล่าว งานวิจัยจำนวนมากที่ทดสอบความคงที่และความสามารถในการวัดความเสี่ยงของค่า beta ได้ชี้ให้เห็นว่าค่า beta ไม่มีประสิทธิภาพในการวัดความเสี่ยงเมื่อเทียบกับปัจจัยอื่น

งานวิจัยในครั้งนี้จะประมวลการทดสอบความคงที่ของค่า beta ของหลักทรัพย์ในตลาดเกิดใหม่ทั้งหมดจำนวน 20 ประเทศที่ได้จากฐานของมูลของ Thompson Datastream การทดสอบว่าปัจจัยอื่นจะสามารถบรรเทาปัญหาเรื่องความคงที่หรือไม่ จะวัดจากประสิทธิภาพในการประเมินผลตอบแทนในอนาคตด้วย beta ที่คำนวณด้วยแบบจำลองที่ใช้ปัจจัยเดียวเทียบกับแบบจำลองสาม ปัจจัยของฟาร์มาและเฟรนช์ (Fama French three factors model) และเทียบกับแบบจำลองลูก ผสมของแบบจำลองสามปัจจัยกับแบบจำลองปัจจัยเดียว

ผลลัพท์ที่สำคัญ 4 อย่างจากงานวิจัยในครั้งนี้มีดังนี้ อันดับแรกผลที่ได้จากงานวิจัยแสดงให้เห็นว่าแบบจำลอง Bayesian ของวาซิเส็ก (Vasicek’s Bayesian Approach) เพิ่มประสิทธภาพในการวัดความเสี่ยงของ beta ที่คำนวณด้วยแบบจำลองที่ใช้ปัจจัยเดียว อันดับที่สองผลจากงานวิจัยชี้ให้เห็นว่าแบบจำลองสมการถดถอยของบลูม (Blume’s Regression Approach) ไม่เพิ่มประสิทธภาพในการวัดความเสี่ยงของ beta อันดับที่สามผลงานวิจัยชี้ว่าแบบจำลองฟาร์มาและเฟรนช์ไม่สามารถอธิบายความเสี่ยงของตลาดเกิดใหม่ และอันดับสุดท้ายผลงานวิจัยบ่งชี้ว่าแบบ จำลองลูกผสมสามารถใช้ได้ผลกับการวัดความเสี่ยงสำหรับช่วงระยะเวลาสั้นๆ เท่านั้น

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CHAPTER I
INTRODUCTION

The Capital Asset Pricing Model (CAPM) which determines the asset prices in an equilibrium framework was developed after Sharpe (1964), Lintner (1965), and Black (1972) documented that beta coefficient could be used as a measurement of the systematic risk. Since then, CAPM has been widely used by many investors as a major tool to analyze the relationship between risk and return due to its simplicity. The results of Bruner et al. (1998) who interviewed 27 best-practice firms in North America, 85% of their sample size used either the CAPM or a modified CAPM in practice. More recent study by Graham and Harvey (2001) indicated that 73.5% of Chief Financial Officers from large companies in U.S and Canada always used CAPM in practice. Despite the popularity and the simplicity of CAPM, many studies such as Blume (1971 and 1975), Gooding and O'Malley (1977), Fama and French (1992, 1993, 1995, and 1996), Brenner and Smidt (1977), and Garbade and Rentzler (1981) have carried out to test the validity of the beta coefficient as a measurement of a systematic risk. Most of these studies focus on testing the stationarity of the beta, its explanatory power and demonstrated that beta is not an effective measurement of systematic risk.

Theoretically, as explained by DeFusco et al. (2007), Green (2008), and Gujarati and Porter (2009), the time series variable is said to be stationary if its properties, such as mean and variance are invariant across time. Three principle requirement for stationary are 1) the mean must be constant and finite in all period; 2) the variance must be constant and finite in all period; and 3) the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed. If the expected value of the time series is not stationary, it would not have economic meaning. Methods such as graphical analysis and correlogram test (auto correlation plot) have been introduced to test the stationary. At a formal level, the researchers used the methods such as transition matrix and unit root tests (such as Augmented Dickey-Fuller test, Phillips-Perron test, and KPSS test) to assess the stationary.

Banz (1981), Basu (1983), Rosenberg et al (1985), and Bhandari (1988) documented the other factors (such as firm size and book-to-market equity) also related to the stock return. The famous study of Fama and French (1992) showed that CAPM's beta coefficient has insignificant cross-sectional explanatory power in the U.S. market after 1963. They founded that the firm size and book-to-market equity could explain the variation in average returns better than beta coefficient. Fama and French (1993) proposed the 3-factor model by adding SMB (small minus big), the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks, and HML (high minus low), into the original CAPM model. They claimed that the 3-factor model could explain the average returns on U.S. stock portfolios constructed on firm size and book-to-market equity better than the single factor model.

Number of investors stated to pay more attention to the investment opportunity in the emerging market since 1980. They believed the stocks in emerging market could improve diversification and could yield high return. Unfortunately, most of the studies on both the beta stationarity issue and the 3-factors issue did not incorporate the data of the entire emerging market. Most of them only focused on some specific countries or a group of countries with big capitalization. For example, Eun and Huang (2002) used China data and Das and Uppal (2003) used Argentina, Hong Kong, Mexico, Singapore, and Thailand data in their studies.

There are 3 main motivations for this study. The first one is to provide a comprehensive examination of beta stationary of entire emerging markets. In order to accomplish this objective, we will use dynamic sample size data to represent the empirical evidence of each sub period. Second motivation is to provide empirical evidence supporting the validity of single index model with Bayesian approach of Vasicek. Our last motivation for this study is to compare the adjustment methods related to beta stationarity issue.

This paper is distinct from previous studies as follow. Firstly, this paper is aimed to provide a comprehensive examination of beta stationarity of the entire set of emerging markets. The data for all 20 emerging countries (as listed by Thompson

Datastream) will be use in our study. In order to investigate whether the other factors could help explain the systematic risk, the beta coefficient calculate with single index model will be compared with one that calculate with multi-index model. Blume's Regression Approach and Vasicek's Bayesian Approach will be use to adjust the beta.

Secondly, since the econometrics treatments for stationarity problem such as the different stationarity process and the trend stationarity process are sophisticate for investors to use. This study is aimed to seek for a simple alternative approach for investors to fix the beta stationarity problem. We will experiment whether the integrated method (a combination of Fama-French 3-factors model and single index model) could improve the stationarity of beta coefficient through time.

The organization for this paper is as follows; the literature review in section 2 will discuss about the classical CAPM , the empirical tests over the validity of beta coefficient in terms of its stationarity and its explanation power (in comparing with the other factors), and the treatments on beta non-stationarity. Section 3 and 4 will discuss about the Data and Methodology and the Empirical Results. Section 5 will discuss about the results and the conclusion.

CHAPTER II
LITERATURE REVIEW

The literature review for this study consists of 3 major parts. The first part would begin with the literature review over the classic capital asset pricing model. The second part would go through the previous empirical studies over beta stationarity issue. And the last part would be about the treatments on stationarity problem.

2.1 The Classic Capital Asset Pricing Model -- CAPM

The CAPM is a model for pricing an individual asset or a portfolio. According to CAPM theory, the 2 risks in portfolio investment are; 1) systematic risk or market risk that could not be eliminated by well-diversified portfolio, but could be measured by beta coefficient and 2) the nonsystematic risk that could be totally eliminated with well-diversified portfolio. According to the simplest form of CAPM model below, the expected return of any stock can be measured by the risk-free rate of return and the market risk premium multiplied by the beta coefficient.

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \qquad (1)$$

where $E(R_i)$ = the expected rate of return of i^{th} stock

R_f = the risk-free rate of return

β_i = the measure of systematic risk of i^{th} stock

$E(R_m)$ = the expected rate of return of market portfolio

By collecting form of equation (1), we will obtain the equilibrium below:

$$E(R_i) - R_f = \beta_i(E(R_m) - R_f) \qquad (2)$$

CAPM assumes that the beta of the overall market is 1.0 and the risk premium of ith stock is proportional to the risk premium of the market. The stocks with beta coefficient greater than 1.0 are riskier than the market, while the stocks with beta coefficient lower than 1.0 are less risky than the market. According to the index model, if we choose equally weighted portfolios, the expected return of each stock will be given by:

$$\tilde{R}_{it} = \alpha_i + \beta_i \widetilde{M}_t + \tilde{\varepsilon}_{it} \qquad (3)$$

where α_i = the intercept whose value is such that the expected value of $\tilde{\varepsilon}_{it}$ to equal to zero

$\tilde{\varepsilon}_{it}$ = the error unique to stock and independent to the market

$\widetilde{M}_t$ = the actual return from the market

β_i = the index of market-related risk for i^{th} stock

2.2 Beta Stationarity

The assumption of CAPM does not explicitly require the beta coefficient to be stable over time. But, the regression method that uses to estimate the beta coefficient treats it as a stable coefficient over time for portfolio analysis. If the beta coefficient of any time period is stationary, it could be used to measure for a risk of later period. Unfortunately, several studies showed contradictory results to this assumption. The problem is of interest after Blume (1971 and 1975) found that the estimated betas tend to regress toward the grand mean of betas (1.0) over time.

In the first study (1971), Blume used monthly total return of NYSE stocks from July 1926 to June 1968 to form 6 equal time periods (7 year each) and different-sized portfolios. The smallest portfolio consisted of 1 stock and the biggest portfolio consisted of 50 stocks. He found that the assessment of future risk of the large portfolios is more accurate than the smaller portfolios. He suggested the investors to adjust the betas because both high and low betas are not stationary.

In the second study (1975), Blume formed 100-stock portfolios from the same data to analyze whether the phenomenon that betas regress toward the grand mean over time is the result from unstable betas or from order bias. He found that the effect of order bias is insignificant. Blume documented a possible reason that may cause the extreme high and low betas to be less extreme over time. He suggested that if the risk of the projects that the company chosen is less extreme over time, the company's equity beta would be less extreme. This suggestion was supported by the study of Brenner and Smidt (1977).

Following Blume studies, Gooding and O'Malley (1977) used t-tests and correlation analysis in their study. They used monthly total returns of 200 largest stocks in the U.S. market (as listed by Fortune in 1974) over bull and bear market phases. The sample consisted of 27 companies from Dow Jones Industrial Index and 169 companies from S&P Industrial Index. Gooding and O'Malley used 3 methods to select the beta as follows 1) random selection; 2) rank-ordering; and 3) rank-ordering for betas with highest r2 to form 3-sized portfolios (consisting of 5, 10, and 20 stocks) for each phase. They found similar result to Blume (1971 and 1975) studies, both of their non-adjusted and adjusted portfolio of both high and low betas were not stable over time. They also found that betas were less extreme over time.

In addition, other researchers such as Altman et al (1974), Baesel (1974), Roenfelt et al (1978), Bos and Newbold (1984), and Kim (1993) also documented the instability of beta coefficient over time and the increase in the stability of beta as the length of the time period increase. Altman et al (1974) used weekly, monthly, and quarterly returns of French Stock Market data in their study. They founded the decreasing in the correlation of the betas calculated with monthly returns. They concluded that the longer the period that one estimates beta, the higher the period-to-period correlation, the higher the beta stationary.

Baesel (1974) and Roenfelt et al (1978) employed the transition matrix technique in their studies and found position relationship of the stability of betas and the length of the estimation periods. Their results also indicated that the estimated betas in the highest risk class and the lowest risk class tend to stay in the same risk class in the subsequent periods.

Kim (1993) investigate whether the length of stationary interval of beta coefficient relate to firm size and the magnitude of the beta itself. Kim found that the size of the firm was not related to the length of stationary interval. According to Kim, only the magnitude of the beta explained the length of stationary interval. In other words, the high betas tend to have more stationary problem than the low betas.

Blume's study also led to several adjustment approaches such as Vasicek (1973)'s Bayesian approach, Merrill Lynch, Pierce, Fenner, & Smith Inc's regression toward one approach. Klemkosky and Martin (1975) compared the forecast power of unadjusted and adjusted betas computed with different adjustment techniques (including Blume's). They founded that the Bayesian approach as documented by Vasicek (1973) outperformed other techniques.

However, Fabozzi and Francis (1978) and Garbade and Rentzler (1981) argued that the adjustment techniques (as mentioned above) did not fix the non-stationarity problem. They believed the adjustment techniques only minimize the order bias error. They introduced econometric technique, namely random coefficients model, for testing the stability of beta coefficients. Their results indicated that beta is a random coefficient. They also concluded that the prediction power of the estimated betas of one period for the subsequent period might be weak because of the randomness of the true betas.

2.3 Treatment on Beta Non-Stationarity

Although the early studies including the study of Fama and MacBeth (1973) found a strong relationship between beta coefficient and the return in U.S. market, many researchers doubt on this relationship. They conducted empirical studies on the explanation power of beta and found that CAPM had failed to explain the reason why small stocks and value stocks tend to have higher returns than the market returns. They also discovered new risk factors that could enhance prediction power of the market beta.

Banz (1981) studied the size effect and found that the market equity could add more explanation power to beta coefficient. He also found that the small firms had higher returns than the large firms during 1926 to 1977. Many researchers doubted the explanation power of beta in comparing with other factors. Basu (1983) and Rosenberg et al (1985) studied the ratio of the book value of a firm's common stock to its market value effect over the average returns and found the positive relationship. Chen et al (1986) studies the effect of macroeconomic factors such as the differences between long term and short term interest rates, risk premium (the difference between government bond and low-grade bond), expected and unexpected inflation rates, and industrial production; over the stock returns. They documented that the stock returns were significantly influenced by the industrial production and the risk premium. Bhandari (1988) studied the leverage effect and found the expected returns are positively related to debt/equity ratios.

Fama and French (1992) used the data from 3 U.S. markets (NYSE, AMEX, and NASDAQ) during1986 to 1989 in their study and found that the variables excluded from CAPM such as firm's size (ME, stock price times number of shares outstanding) and its book-to-market equity (the ratio of the book value of a firm's common stock, BE, to its market value, ME) have more explanation power on the cross-section of the average returns of US stocks than beta coefficient. They found that most of the stocks with small ME and high BE/ME ratio tend to have higher rate of return than the average stocks. They also found no relationship between the beta and the expected return.

According to Fama and French, investors concern on various risk factors rather the market risk alone. But the combination the risks related to market, size, and value give the best prediction power. The stock return reflexes the cost of capital of each firm. Small firms would have to pay more when borrowing or issuing stocks. Poor value firms (firms with poor financial performance, poor earning, and bad management) would have to pay more when seeking for capital as well. Therefore the stock prices of small firms and bad value firms are generally lower than the big and good value firms. All investors automatically take the market risk plus additional risks related to firm size and value.

In their further study, Fama and French (1993) added two factors; SMB and HML into the original CAPM single factor and found that these two factors were able to explain the expected return while this was not possible with beta. Fama and

French (1995 and 1996) demonstrated that weak firms with low earnings tend to have high BE/ME ratio and positive slopes on HML while strong firms with high earnings tend to have low BE/ME and negative slopes on HML. They concluded that BE/ME ratio and slope on HML could proxy for relative distress.

These previous studies demonstrated two important implications. The first one is that the investors may not use the beta in the past to estimate future beta because beta is not stable over time. Second, the variables that excluded from CAPM such as BE/ME ratio is a powerful predictor of expected return.

CHAPTER III
DATA AND METHODOLOGY

Weekly return indexes of all common stocks listed in 7 Latin American Markets (Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela), 9 Asian Markets (China, India, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Taiwan, Thailand), 2 European Markets (Russia, Turkey), 1 Middle East Market (Israel), and 1 African Market (South Africa) from September 24, 1999 to September 18, 2009 was taken from Thompson Datastream. Thompson Datastream calculated the return index with equation below:

$$RI_t = RI_{t-1} * \frac{PI_t}{PI_{t-1}} * \left[1 + \frac{DY*f}{n}\right] \tag{4}$$

where RI_t = return index on day t

RI_{t-1}= return index on previous day

PI_t = price index on day t

PI_{t-1}= price index on previous day

DY = dividend yield of the price index

f = grossing factor (normally 1) - if the dividend yield is a net figure rather than gross, is used to gross up the yield

n = number of days in financial year (normally 260)*100.

In our analysis, the weekly return of i^{th} stock is utilized in a form as follow:

$$R_{it} = \frac{RI_t - RI_{t-1}}{RI_{t-1}} \tag{5}$$

Total Emerging Markets Index called TOTMKEK Index of Thompson Datastream was used as a market index for this study. One year India Treasury bill is used as the risk-free rate to calculate the excess return of each stock. The length of the entire data for each stock is 521 weekly observations (beginning in October 1, 1999 and ending in September 18, 2009), allowed the data to be divided into sub periods of 2-year, 2.5-year, 5-year, and 10-year which contains 104, 130, 260, and 520 weekly observations respectively plus 1 additional weekly return for MSE calculation. The returns of the stock that were not traded for 12 consecutive weeks are excluded from our studies.

Table 3.1 provides descriptive statistics of the data for each sub period. According to the result of the 2-year sub period on panel A, the number of the companies varied from 5,308 to 6,182. The mean and the standard deviation of the estimated beta were not stable overtime. The mean increased in second and third period, but decreased in fourth and fifth period. The standard deviation decreased in every period except fifth period that it was significantly increased. We suspected that this instability might caused by number of negative betas and the extremely low betas (beta < -5) and extremely high betas (beta > 3) in each period.

Panel B provides the number of stocks of each country for each sub period. Panel C provides the names of the stocks with lowest (minimum) and highest (maximum) betas. All of the stocks with lowest betas survived in later period. However, some of highest beta stocks were dead or delisted or suspended in later period (These stocks were traded in South Africa). The results of 2.5-year and 5-year sub periods also indicated the instability of the mean and the standard deviation of the estimated betas. We suspected that the reverse direction of the mean and the standard deviation may caused by the extremely low beta.

Next section, transition matrices are used to quantify the change in beta coefficients of individual stocks over time. Product moment and rank order correlation methods are employed to accomplish the tests.

3.1 Descriptive Summary of Beta Coefficient (Panel A)

Period	No. of Stocks	Mean	Std Dev	No. of Beta<0	0.10	0.25	0.50	0.75	0.90	Min Beta	Max Beta
2-Year Period											
10/01/99-09/21/01	5,308	0.545828	0.633752	746	-0.055558	0.136000	0.440815	0.807827	1.354066	-6.373447	4.374250
09/28/01-09/19/03	5,376	0.573877	0.538675	362	0.062246	0.196037	0.443226	0.863316	1.326722	-1.710537	3.202532
09/26/03-09/16/05	5,614	0.627477	0.505256	300	0.147469	0.341510	0.573145	0.901729	1.223102	-11.627394	5.704654
09/23/05-09/14/07	5,877	0.613284	0.466700	497	0.037739	0.306853	0.608590	0.904981	1.204673	-5.536360	3.019392
09/21/07-09/11/09	6,182	0.548429	1.115552	386	0.049123	0.218889	0.532818	0.841941	1.150467	-58.913752	2.400126
2.5-Year Period											
10/01/99-03/22/02	5,097	0.558895	0.613634	531	-0.006372	0.168275	0.447305	0.786018	1.367494	-9.964726	3.512822
03/29/02-09/17/04	5,334	0.591341	0.472618	285	0.089590	0.235347	0.528833	0.891742	1.242091	-3.979777	2.579851
09/24/04-03/16/07	5,687	0.586319	0.464031	395	0.075717	0.298680	0.557512	0.850763	1.160106	-8.417157	3.324096
03/23/07-09/11/09	5,927	0.554919	1.103638	308	0.064106	0.241290	0.554906	0.846417	1.116177	-57.381011	2.273967
5-Year Period											
10/01/99-09/17/04	4,396	0.576133	0.495347	218	0.063909	0.221168	0.502682	0.824702	1.282910	-6.978802	2.378190
09/24/04-09/11/09	5,046	0.552946	1.055039	189	0.091560	0.247154	0.552440	0.837696	1.100134	-50.654591	1.990831
10-Year Period											
10/01/99-09/11/09	3,470	0.583972	0.863084	70	0.105956	0.288145	0.604758	0.858257	1.097945	-33.005814	1.841773

These non adjusted beta coefficients were calculated with weekly excess returns and TOTMKEK index.

3.2 Descriptive Summary of Beta Coefficient (Panel B)

Period/Country	AG	BR	CL	CN	CB	IN	ID	IS	MY	MX	PK	PE	PH	RS	SA	SL	TW	TH	TK	VN
2-Year Period																				
10/01/99-09/21/01	38	165	106	922	15	813	187	354	661	66	167	38	128	26	373	113	634	261	228	13
09/28/01-09/19/03	32	135	89	1125	17	766	168	284	673	64	149	36	90	43	268	108	816	247	261	5
09/26/03-09/16/05	31	131	86	1230	17	752	157	267	739	59	135	35	82	43	228	109	981	262	264	6
09/23/05-09/14/07	30	126	81	1194	16	750	145	283	837	57	136	34	82	44	212	115	1115	344	269	7
09/21/07-09/11/09	35	180	82	1282	15	834	128	356	788	60	36	32	91	80	239	116	1158	378	287	5
2.5-Year Period																				
10/01/99-03/22/02	35	148	101	918	12	761	179	327	654	66	155	37	119	25	338	110	618	255	228	11
03/29/02-09/17/04	31	134	86	1120	18	741	161	278	675	60	135	36	83	44	240	104	871	248	264	5
09/24/04-03/16/07	30	119	80	1238	14	735	140	270	776	58	131	34	82	37	211	110	1048	301	267	6
03/23/07-09/11/09	33	141	81	1225	14	798	121	320	777	59	36	29	83	74	218	116	1144	372	281	5
5-Year Period																				
10/01/99-09/17/04	29	124	85	854	12	658	129	235	594	55	131	33	80	21	226	102	568	234	221	5
09/24/04-09/11/09	29	101	71	1103	13	689	106	242	644	50	35	25	75	29	185	106	1001	281	256	5
10-Year Period																				
10/01/99-09/11/09	27	88	67	648	8	568	87	190	448	42	32	22	71	9	167	93	497	199	203	4

These non adjusted beta coefficients were calculated with weekly excess returns and TOTMKEK index.

3.3 Descriptive Summary of Beta Coefficient (Panel C)

Period	Min Beta	Stock Name	Country	Max Beta	Stock Name	Country
2-Year Period						
10/01/99-09/21/01	-6.373447	AVTOVAZ	Russia	4.374250	ADMIRAL LEIS.WLD. DEAD - 10/05/04 -	South Africa
09/28/01-09/19/03	-1.710537	SUMALINDO LESTARI JAYA	Indonesia	3.202532	MOULDED MED.SUPS. DEAD - 04/03/06 -	South Africa
09/26/03-09/16/05	-11.627394	BANFALC1	Peru	5.704654	ORIENT SEMICON.ELTN.	Taiwan
09/23/05-09/14/07	-5.536360	MELISRON	Israel	3.019392	HARVEST COURT	Malaysia
09/21/07-09/11/09	-58.913752	KUMPULAN JETSON	Malaysia	2.400126	TOPSPIN MEDICAL	Israel
2.5-Year Period						
10/01/99-03/22/02	-9.964726	DMCI HOLDINGS	Philippines	3.512822	ADMIRAL LEIS.WLD. DEAD - 10/05/04 -	South Africa
03/29/02-09/17/04	-3.979777	BOSCH FREN SIST.SANVETC.	Turkey	2.579851	AFRICAN MEDIA ENTM.	South Africa
09/24/04-03/16/07	-8.417157	BANFALC1	Peru	3.324096	ORIENT SEMICON.ELTN.	Taiwan
03/23/07-09/11/09	-57.381011	KUMPULAN JETSON	Malaysia	2.273967	TOPSPIN MEDICAL	Israel
5-Year Period						
10/01/99-09/17/04	-6.978802	DMCI HOLDINGS	Philippines	2.378190	SILICOM	Israel
09/24/04-09/11/09	-50.654591	KUMPULAN JETSON	Malaysia	1.990831	UNITECH	India
10-Year Period						
10/01/99-09/11/09	-33.005814	KUMPULAN JETSON	Malaysia	1.841773	GERDAU PN	Brazil

These non adjusted beta coefficients were calculated with weekly excess returns and TOTMKEK index.

CHAPTER IV
EMPIRICAL RESULTS

This chapter begins with the result of stability test. Then the selected treatments for beta stationarity problem will be explored in detail. Last part, we will compare the selected treatments over multiple sub periods and multiple portfolio size.

4.1 Stability Test

Table 4.1, 4.2, and 2.2 present the transition matrix of estimated beta coefficients computed over multiple 2-year, 2.5-year, and 5-year sub periods. Risk class five was the highest risk class and class one the lowest in each case. The following example indicates a proper interpretation of the elements of the table. Consider the (1,1) element of the first sub period pair (t = 10/01/99-09/21/01, t+1 = 09/28/01-09/19/03) of Table 4.1, which has the value of 0.36. This means that 36 per cent of all stocks, which were in the lowest risk class in period t, were also in the lowest risk class in period t+1. The (1,5) element indicates that 3 per cent of the stocks in the lowest risk class in time period t were in the highest risk class in period t+1. The left to right, top to bottom diagonal contains relative frequency with which stocks remained in the same risk class.

The results of 2-year sub period betas on table 4.1 indicated that 27-58 per cent of stocks with the extreme low risk class tend to remain in the same risk class in the subsequent period. For the extreme high risk class, 42-56 per cent of stocks tend to remain in the same risk class in the subsequent period. And for the middle risk class, 21-30 per cent of stocks in this risk class tend to remain in the same risk class in the subsequent period.

According to the results of 2.5-year sub period on table 4.2, 44-47 per cent of stocks with the extreme low risk, 34-59 per cent of stocks with the extreme low risk high risk, and 22-31 per cent of stocks with middle risk class tend to remain in the same risk classes in the later period. For the 5-year sub period, table 4.3 indicated 68 per cent of stocks with the extreme low risk, 42 per cent of stocks with the extreme high risk, and 30 per cent of stocks with the middle risk class remained in the same risk classes in a subsequent period.

Our results confirm the results of previous studies that individual stock betas are unstable. The results indicate a high chance that the stocks with extreme low/high risk will retain their original risk class in later periods. The chi-square statistic of each table is significant at the 1% level indicating the frequencies are not likely to have occurred by chance.

4.1 Transition Matrix of Estimated Betas (2-Year Sub Period)

	Risk Class Period T+1 (09/28/01-09/19/03)					
Risk Class Period T (10/01/99-09/21/01)		1	2	3	4	5
	1	0.36	0.37	0.15	0.08	0.04
	2	0.29	0.29	0.24	0.13	0.04
	3	0.17	0.18	0.29	0.25	0.11
	4	0.11	0.10	0.23	0.31	0.25
	5	0.07	0.05	0.09	0.23	0.56

	Risk Class Period T+1 (09/26/03-09/16/05)					
Risk Class Period T (09/28/01-09/19/03)		1	2	3	4	5
	1	0.27	0.29	0.22	0.14	0.08
	2	0.24	0.31	0.24	0.13	0.07
	3	0.24	0.21	0.21	0.21	0.14
	4	0.18	0.12	0.20	0.25	0.26
	5	0.07	0.06	0.13	0.28	0.45

	Risk Class Period T+1 (09/23/05-09/14/07)					
Risk Class Period T (09/26/03-09/16/05)		1	2	3	4	5
	1	0.33	0.28	0.18	0.11	0.11
	2	0.34	0.28	0.16	0.13	0.09
	3	0.21	0.23	0.23	0.20	0.13
	4	0.09	0.14	0.26	0.27	0.24
	5	0.04	0.08	0.17	0.29	0.42

	Risk Class Period T+1 (09/21/07-09/11/09)					
Risk Class Period T (09/23/05-09/14/07)		1	2	3	4	5
	1	0.58	0.29	0.08	0.03	0.02
	2	0.26	0.32	0.24	0.12	0.06
	3	0.09	0.19	0.30	0.28	0.14
	4	0.04	0.13	0.23	0.32	0.27
	5	0.03	0.07	0.14	0.25	0.51

4.2 Transition Matrix of Estimated Betas (2.5-Year Sub Period)

		Risk Class Period T+1 (03/29/02-09/17/04)				
		1	2	3	4	5
Risk Class Period T (10/01/99-03/22/02)	1	0.47	0.33	0.10	0.06	0.04
	2	0.26	0.31	0.23	0.14	0.07
	3	0.13	0.19	0.31	0.24	0.12
	4	0.09	0.11	0.23	0.33	0.24
	5	0.05	0.05	0.13	0.23	0.53

		Risk Class Period T+1 (09/24/04-03/16/07)				
		1	2	3	4	5
Risk Class Period T (03/29/02-09/17/04)	1	0.44	0.24	0.16	0.09	0.07
	2	0.32	0.27	0.18	0.12	0.11
	3	0.13	0.24	0.22	0.23	0.18
	4	0.07	0.15	0.24	0.23	0.31
	5	0.05	0.10	0.20	0.32	0.34

		Risk Class Period T+1 (03/23/07-09/11/09)				
		1	2	3	4	5
Risk Class Period T (09/24/04-03/16/07)	1	0.46	0.34	0.14	0.04	0.02
	2	0.28	0.32	0.23	0.12	0.04
	3	0.17	0.20	0.30	0.24	0.10
	4	0.07	0.10	0.23	0.36	0.24
	5	0.02	0.05	0.11	0.24	0.59

4.3 Transition Matrix of Estimated Betas (5-Year Sub Period)

		Risk Class Period T+1 (09/24/04-09/11/09)				
		1	2	3	4	5
Risk Class Period T (10/01/99-09/17/04)	1	0.68	0.19	0.05	0.03	0.05
	2	0.22	0.34	0.19	0.15	0.10
	3	0.05	0.22	0.30	0.24	0.18
	4	0.03	0.16	0.26	0.29	0.26
	5	0.01	0.09	0.19	0.29	0.42

Table 4.4, 4.5, and 4.6 present product moment and rank order correlation coefficients of estimated beta coefficients computed over 2-year, 2.5-year, and 5-year sub periods. Different-size portfolios are used for our examination. Smallest portfolio consisted of 1 beta and biggest portfolio consisted of 1,000 betas. The estimated betas are sorted in ascending order. A first N-stock portfolio consisted of a first set of

smallest betas. A second N-stock portfolio consisted of a next set of the smallest betas. A last N-stock portfolio consisted of a last set of the highest betas.

The results of 2-year sub periods were slightly different from the results of 2.5-year and 5-year sub period. The results of 2-year sub periods indicated that the product moment continued to increase as the number of stocks per portfolio increased from 1 to 100. However, when the number of stocks per portfolios is reached over 250, the product moment coefficients tend to decrease. But for 2.5-year and 5-year sub periods, the product moment continued to increase as the number of stocks per portfolio increased from 1 to 250 and tend to decrease after the number of stocks per portfolio is reached over 250.

Rank order correlation coefficients of 500-stock portfolios of almost all periods were equal or closed to 1.0. This indicated that the assessments of future betas are reliable for portfolios containing 500 stocks. The estimated betas of 500-stock portfolios in 2 successive periods of 2-year, 2.5-year, and 5-year sub periods are presented in table 4.7, 4.8, and 4.9 respectively. Small risk portfolios tend to have higher risk in subsequent periods. While high risk portfolios tend to have lower risk in subsequent periods.

4.4 Product Moment and Rank Order Correlation Coefficient (2-Year Sub Period)

No. of Stocks per Port	10/01/99-09/21/01 to	09/28/01-09/19/03	09/28/01-09/19/03 to	09/26/03-09/16/05	09/26/03-09/16/05 to	09/23/05-09/14/07	09/23/05-09/14/07 to	09/21/07-09/11/09
	P.M.	Rank	P.M.	Rank	P.M.	Rank	P.M.	Rank
1	0.491015	0.548712	0.349182	0.395544	0.364808	0.449280	0.209800	0.648727
2	0.598701	0.662312	0.460529	0.488677	0.481032	0.562103	0.290807	0.758847
4	0.705454	0.781573	0.588173	0.593520	0.596017	0.670521	0.392493	0.853986
7	0.765241	0.845268	0.690891	0.680201	0.678974	0.742565	0.489140	0.908596
10	0.791284	0.881240	0.750968	0.722318	0.740433	0.788864	0.556129	0.926709
20	0.851068	0.931298	0.834653	0.803681	0.817876	0.847041	0.683370	0.949791
35	0.874771	0.948261	0.878501	0.856003	0.875420	0.887199	0.763861	0.951463
50	0.893647	0.962303	0.887195	0.878800	0.876315	0.890416	0.811059	0.943396
75	0.918769	0.971103	0.907856	0.914748	0.891889	0.903004	0.855575	0.932730
100	0.922320	0.986166	0.905977	0.924286	0.901563	0.905158	0.873080	0.940735
250	0.908195	0.987616	0.904300	0.964912	0.882018	0.930827	0.895476	0.942857
500	0.878212	1.000000	0.859194	0.950000	0.840406	0.915152	0.863265	0.951515

4.5 Product Moment and Rank Order Correlation Coefficient (2.5-Year Sub Period)

No. of Stocks per Port	10/01/99-03/22/02 to 03/29/02-09/17/04		03/29/02-09/17/04 to 09/24/04-03/16/07		09/24/04-03/16/07 to 03/23/07-09/11/09	
	P.M.	Rank	P.M.	Rank	P.M.	Rank
1	0.449914	0.567792	0.392639	0.465689	0.216056	0.659002
2	0.559455	0.677474	0.510802	0.582550	0.298087	0.774366
4	0.652116	0.769583	0.632329	0.705096	0.403683	0.860739
7	0.712494	0.842200	0.716252	0.789104	0.502104	0.905505
10	0.747195	0.875427	0.759202	0.830706	0.574596	0.928320
20	0.814575	0.925229	0.833369	0.882951	0.698223	0.951525
35	0.846482	0.945696	0.862663	0.924790	0.784902	0.954087
50	0.878160	0.966738	0.876078	0.929137	0.816688	0.949055
75	0.886680	0.970716	0.892180	0.958242	0.856719	0.933634
100	0.892108	0.977046	0.895081	0.957447	0.871463	0.924706
250	0.912096	0.992647	0.883065	0.975439	0.894080	0.969925
500	0.863662	1.000000	0.847811	1.000000	0.869211	0.951515

4.6 Product Moment and Rank Order Correlation Coefficient (5-Year Sub Period)

No. of Stocks per Port	10/01/99-09/17/04 to 09/24/04-09/11/09	
	P.M.	Rank
1	0.165597	0.612502
2	0.233363	0.708983
4	0.319589	0.791054
7	0.404404	0.849063
10	0.458858	0.867104
20	0.579172	0.887770
35	0.683982	0.920309
50	0.742920	0.913409
75	0.795237	0.891212
100	0.806219	0.911383
250	0.835488	0.934066
500	0.808002	0.942857

4.7 Estimated Betas of 500-Stock Port in 2-Successive Period (2-Year Sub Period)

Port No.	10/01/99-09/21/01	09/28/01-09/19/03	09/28/01-09/19/03	09/26/03-09/16/05	09/26/03-09/16/05	09/23/05-09/14/07	09/23/05-09/14/07	09/21/07-09/11/09
1	-0.253086	0.230851	-0.113058	0.458839	-0.151295	0.415191	-0.187100	0.138243
2	0.030901	0.276904	0.120692	0.448955	0.220928	0.448202	0.134266	0.197661
3	0.168069	0.308552	0.203236	0.454018	0.337170	0.427658	0.291261	0.304044
4	0.302472	0.396828	0.287074	0.514328	0.426684	0.413523	0.424001	0.289381
5	0.433551	0.494863	0.387625	0.538883	0.521682	0.500387	0.535800	0.519254
6	0.579565	0.536190	0.518428	0.585550	0.626117	0.571113	0.636484	0.588212
7	0.746023	0.678310	0.674400	0.635932	0.743322	0.691443	0.735422	0.665962
8	1.012650	0.862214	0.865491	0.753678	0.893266	0.758202	0.844672	0.732386
9	1.683290	1.149387	1.129154	0.840330	1.073091	0.852315	0.975636	0.664992
10					1.370032	0.979808	1.168973	0.874746

4.8 Estimated Betas of 500-Stock Port in 2-Successive Period (2.5-Year Sub Period)

Port No.	10/01/99-03/22/02	03/29/02-09/17/04	03/29/02-09/17/04	09/24/04-03/16/07	09/24/04-03/16/07	03/23/07-09/11/09
1	-0.189753	0.251582	-0.076732	0.296254	-0.117561	0.212881
2	0.083218	0.285742	0.154468	0.333255	0.174080	0.271592
3	0.212080	0.365231	0.250589	0.400533	0.304041	0.206065
4	0.342763	0.513414	0.360206	0.496386	0.405976	0.427570
5	0.472405	0.554567	0.491576	0.586331	0.509395	0.461988
6	0.619556	0.626937	0.626573	0.697158	0.615547	0.580326
7	0.791568	0.734847	0.771731	0.766666	0.730408	0.663594
8	1.160361	0.933407	0.953945	0.791247	0.856686	0.643062
9			1.202593	0.793593	1.025800	0.861099
10					1.367021	1.049725

4.9 Estimated Betas of 500-Stock Port in 2-Successive Period (5-Year Sub Period)

Port No.	10/01/99-09/17/04	09/24/04-09/11/09
1	-0.022072	0.215871
2	0.205333	0.327579
3	0.378267	0.455800
4	0.532303	0.673063
5	0.697767	0.637340
6	0.951738	0.796731

4.2 Treatment 1: Adjustment Procedures

In this study, we will explore 2 different adjustment techniques. The first one is Blume (1971)'s Regression Approach which uses the regression coefficient from 2-adjacent periods to forecast the subsequent period. Second technique is Vasicek (1973)'s Bayesian Approach. The following equation is use for the first approach.

$$\beta_{i2} = a + b\beta_{i1} \qquad (6)$$

where a = regression coefficient

b = regression coefficient

β_{i1}= estimated beta for stock i^{th} of previous period

β_{i2}= estimated beta for stock i^{th} of one period

Table 4.10 presents the regression coefficients for Blume's approach from 4 successive 2-year sub periods; 3 successive 2.5-year sub periods; and 1 successive 5-year sub periods for individual stocks. For every successive period, the coefficients on this table will be use to adjust the beta of individual stock for a second period. The adjusted beta will be use to estimate the predicted return for subsequent period.

4.10 Regression Coefficients for Blume's Regression Approach

Regression Tendency Implied Between Periods	$\beta_2 = a + b\beta_1$
2-Year Period	
09/28/01-09/19/03 and 10/01/99-09/21/01	$\beta_2 =$ 0.33851 + 0.40341 β_1
09/26/03-09/16/05 and 09/28/01-09/19/03	$\beta_2 =$ 0.42860 + 0.34889 β_1
09/23/05-09/14/07 and 09/26/03-09/16/05	$\beta_2 =$ 0.37555 + 0.38260 β_1
09/21/07-09/11/09 and 09/23/05-09/14/07	$\beta_2 =$ 0.19830 + 0.53654 β_1
2.5-Year Period	
03/29/02-09/17/04 and 10/01/99-03/22/02	$\beta_2 =$ 0.38951 + 0.33382 β_1
09/24/04-03/16/07 and 03/29/02-09/17/04	$\beta_2 =$ 0.37610 + 0.38541 β_1
03/23/07-09/11/09 and 09/24/04-03/16/07	$\beta_2 =$ 0.20045 + 0.57353 β_1
10-Year Period	
09/24/04-09/11/09 and 10/01/99-09/17/04	$\beta_2 =$ 0.32878 + 0.41090 β_1

The equation below is used for Vasicek's Bayesian Approach.

$$\beta_{i2} = \frac{\overline{\beta_1}/S_{\overline{\beta 1}}^{\ 2} + \beta_{i1}/S_{\beta 1}^{\ 2}}{1/S_{\overline{\beta 1}}^{\ 2} + 1/S_{\beta 1}^{\ 2}} \tag{7}$$

where $S_{\beta 1}^{\ 2}$ = variance in estimate of β_{i1}

β_{i1} = estimated beta for stock i^{th} of previous period

β_{i2} = estimated beta for stock i^{th} of one period

$\overline{\beta_1}$ = mean of cross section beta of previous period

$S_{\overline{\beta 1}}^{\ 2}$ = variance of cross section beta of previous period

The above equation for Vasicek's Bayesian Approach was initiated from the assumption that betas tend to regress toward the grand mean of betas (1.0) over time as Blume's Regression Approach. According to Vasicek (1973), the quality of the historical beta of stock i^t would decrease as the variance of the error increases. So we should be placed the weight on the cross sectional mean. And if the quality of the historical beta increases as the variance of the error decreases, the weight should be placed on beta. Hence, the adjusted (predicted) beta of stock i^{th} for a subsequent period is the result of the weighted average of the historical beta of stock i^t and the average of the cross sectional betas of previous period.

4.3 Treatment 2: Fama-French 3-Factor Model

We also employed Fama-French 3-Factor Model to correct the inefficiency in beta forecast using the following functional form.

$$R_{it} - R_f = \alpha_i + b_i(R_{mt} - R_f) + s_i SMB + h_i HML + \varepsilon \tag{8}$$

where SMB = the return of small stocks portfolio less the return of large stocks portfolio

HML = the return of portfolio of high BE/ME ratios less the return of low

BE/ME portfolio

R_{it} = the expected rate of return of i^{th} stock at period t

R_f = the risk-free rate of return

α_i = the intercept whose value is such that the expected value of $\tilde{\varepsilon}_{it}$ to equal to zero

b_i = the index of market-related risk for i^{th} stock

s_i = the index of size-related risk for i^{th} stock

h_i = the index of value-related risk for i^{th} stock

R_{mt} = the expected rate of return of market portfolio at period t

ε = the error unique to stock and independent to the market

We used all the valid stocks from BRIC Markets (Brazil, Russia, India and China) to compute SMB and HML in this study. According to our data screening as shown in Appendix Section, 37.36-41.36 per cent of valid stocks with ME and BE/ME ratios were traded in BRIC Market every year. Throughout the 10-year period, BRIC coverage accounted for 40.68 per cent of the entire emerging markets. Our data allowed us to calculated SMB and HML for 2-year, 2.5-year, 5-year, and 10-year sub periods. Hence we were able to use Fama-French 3-factor model to predict the returns for multi-sub periods in accordance with the available SMB and HML for each different sub periods.

4.4 Treatment 3: Integrated Methods

A combination of Fama-French 3-factor model and single index model is employed as integrated method for this study. Thus, we suspect that the stationarity problem of beta coefficients may cause by the instability of the excess returns we used to calculate the betas. We would like to test if the adjusted returns could help increase the prediction power of the beta. All weekly excess returns will be adjusted with Fama-French 3-factor model, and will be use to estimated single index beta for predicting the returns for the subsequent period.

The first integration method followed the steps below:

1. Use Fama-French 3-factor model to the regress excess return of each stock with the market return, SMB, HML of each 2-year, 2.5-year, 5-year, and 10-year sub periods.
2. Use the regression coefficients (b_i, s_i, and h_i) from step 1 to calculate adjusted returns for each 2-year, 2.5-year, 5-year, and 10-year sub periods. (b_i, s_i, and h_i of 2-year sub periods will be used to calculate the adjust returns for each 2-year sub periods,….., and b_i, s_i, and h_i of 10-year sub periods will be used to calculate the adjust returns for 10-year sub period)
3. Use the adjusted returns for each 2-year, 2.5-year, 5-year, and 10-year sub periods from step 2 to calculate new single index beta for each 2-year, 2.5-year, 5-year, and 10-year sub periods respectively.

The second integration method used the following steps:

1. Use Fama-French 3-factor model to regress excess return of each stock with the market return, SMB, HML of each 2-year sub period.
2. Use the regression coefficients (b_i, s_i, and h_i) from step 1 to calculate adjusted returns for each 2-year sub periods.
3. Group the adjusted returns from step 2 into 2-year, 2.5-year, 5-year, and 10-year sub periods, then calculate new single index beta for each sub periods.

In order to assess whether these 2 integrated methods could stabilize the betas. The descriptive summaries and the stationarity test results of both integrated betas must be compared with those of single index model betas. Table 4.11 indicated that the descriptive summaries of the betas calculated with the first integrated method and the unadjusted betas (as presented in table 3.1-3.3) were similar for all sub periods. While table 4.12 showed that betas calculated with the second integrated method were slightly different from the unadjusted betas for the 2.5-year, 5-year, and 10-year sub periods.

Thus we only used the 2-year sub period data to adjust the returns which were used to calculate the betas for the second method. We suspected that the reduction in the number of stocks for 2.5-year and 5-year sub periods on table 4.12 may caused by such method. Mean and standard deviation for 2.5-year, 5-year, and 10-year sub periods of second integrated method's betas were generally lower than the first method. And the magnitude of the lowest and the highest betas of second integrated method were also less extreme than those of the first integrated method and the single index model. Table 4.13 and table 4.14 present the number of valid stocks for each market during each sub periods for the first and the second integrated method respectively.

The results of the first integrated method for all sub periods on table 4.15 were similar to the results of the original single index beta which presented earlier on table 3.3. For the second integrated method, while table 4.16 indicated that the results of 2-year sub period betas were the same as the first integrated method and the single index model. The result 2.5-year, 5-year, and 10-year sub periods betas of the second method were not. Some of the lowest and highest beta stocks for second method for 2.5-year, 5-year, and 10-year sub periods were different from the first method and the single index model. We suspected these differences were caused by the compute method we used for the second integrated method. However, the results on table 4.16 still indicated the fact that some of highest beta stocks those were dead or delisted or suspended later were traded in South Africa Market; as table 3.3 and 4.15 indicated before.

Next, in order to investigate whether both integrated methods could have any effect over the stationarity issue. We will examine the stationarity of integrated betas with transition matrix, product moment, and rank order correlation techniques as we did with the single index model betas in the beginning of this chapter.

4.11 Descriptive Summary of Integrated Method 1's Betas (Panel A)

Period	No. of Stocks	Mean	Std Dev	No. of Beta<0	0.10	0.25	0.50	0.75	0.90	Min Beta	Max Beta
2-Year Period											
10/01/99-09/21/01	5,308	0.545828	0.633752	746	-0.055558	0.136000	0.440815	0.807827	1.354066	-6.373447	4.374250
09/28/01-09/19/03	5,376	0.573877	0.538675	362	0.062246	0.196037	0.443226	0.863316	1.326722	-1.710537	3.202532
09/26/03-09/16/05	5,614	0.627477	0.505256	300	0.147469	0.341510	0.573145	0.901729	1.223102	-11.627394	5.704654
09/23/05-09/14/07	5,877	0.613284	0.466700	497	0.037739	0.306853	0.608590	0.904981	1.204673	-5.536360	3.019392
09/21/07-09/11/09	6,182	0.548429	1.115552	386	0.049123	0.218889	0.532818	0.841941	1.150467	-58.913752	2.400126
2.5-Year Period											
10/01/99-03/22/02	5,097	0.558895	0.613634	531	-0.006372	0.168275	0.447305	0.786018	1.367494	-9.964726	3.512822
03/29/02-09/17/04	5,334	0.591341	0.472618	285	0.089590	0.235347	0.528833	0.891742	1.242091	-3.979777	2.579851
09/24/04-03/16/07	5,687	0.586319	0.464031	395	0.075717	0.298680	0.557512	0.850763	1.160106	-8.417157	3.324096
03/23/07-09/11/09	5,927	0.554919	1.103638	308	0.064106	0.241290	0.554906	0.846417	1.116177	-57.381011	2.273967
5-Year Period											
10/01/99-09/17/04	4,396	0.576133	0.495347	218	0.063909	0.221168	0.502682	0.824702	1.282910	-6.978802	2.378190
09/24/04-09/11/09	5,046	0.552946	1.055039	189	0.091560	0.247154	0.552440	0.837696	1.100134	-50.654591	1.990831
10-Year Period											
10/01/99-09/11/09	3,470	0.583972	0.863084	70	0.105956	0.288145	0.604758	0.858257	1.097945	-33.005814	1.841773

These integrated beta coefficients were calculated with weekly adjusted returns and TOTMKEK index. In order to adjust the weekly returns, ordinary excess returns, SMB, and HML for each 2-year, 2.5-year, 5-year, and 10-year sub period were plugged in Fama-French 3-factor model to calculate b_i, s_i, and h_i for 2-year, 2.5-year, 5-year, and 10-year sub period respectively. Then TOTMKEK index, SMB, HML, b_i, s_i, and h_i for each sub period were plugged back into Fama-French 3-factor model to calculate weekly adjusted returns for each sub period.

4.12 Descriptive Summary of Integrated Method 2's Betas (Panel A)

Period	No. of Stocks	Mean	Std Dev	No. of Beta<0	0.10	0.25	0.50	0.75	0.90	Min Beta	Max Beta
2-Year Period											
10/01/99-09/21/01	5,308	0.545828	0.633752	746	-0.055558	0.136000	0.440815	0.807827	1.354066	-6.373447	4.374250
09/28/01-09/19/03	5,376	0.573838	0.538648	362	0.062246	0.196037	0.443226	0.863070	1.326722	-1.710537	3.202532
09/26/03-09/16/05	5,614	0.627477	0.505256	300	0.147469	0.341510	0.573145	0.901729	1.223102	-11.627394	5.704654
09/23/05-09/14/07	5,877	0.613289	0.466697	497	0.037739	0.306853	0.608590	0.904981	1.204673	-5.536360	3.019392
09/21/07-09/11/09	6,182	0.548429	1.115552	386	0.049123	0.218889	0.532818	0.841941	1.150467	-58.913752	2.400126
2.5Yrs Period											
10/01/99-03/22/02	4,568	0.556067	0.573048	464	-0.001695	0.167915	0.453468	0.800040	1.369798	-5.034277	2.782664
03/29/02-09/17/04	4,999	0.586847	0.450919	161	0.123839	0.243744	0.497883	0.863977	1.222004	-4.230575	3.887300
09/24/04-03/16/07	5,103	0.613911	0.414633	297	0.100625	0.335055	0.608584	0.878146	1.136552	-3.865977	2.435216
03/23/07-09/11/09	5,361	0.543329	1.083712	260	0.071048	0.234695	0.535632	0.832913	1.097120	-53.551645	2.250701
5Yrs Period											
10/01/99-09/17/04	4,242	0.565180	0.482808	217	0.064000	0.207043	0.481243	0.799758	1.294577	-2.777064	2.498581
09/24/04-09/11/09	4,648	0.564588	0.964224	156	0.094906	0.259912	0.565762	0.850722	1.098848	-43.671530	1.951038
10Yrs Period											
10/01/99-09/11/09	3,470	0.583518	0.792150	67	0.106509	0.284346	0.599574	0.852993	1.091955	-29.604177	1.847836

These integrated beta coefficients were calculated with weekly adjusted returns and TOTMKEK index. In order to adjust the weekly returns, ordinary excess returns, SMB, and HML for each 2-year sub period were plugged in Fama-French 3-factor model to calculate b_i, s_i, and h_i for 2-year sub period. Then TOTMKEK index, SMB, HML, b_i, s_i, and h_i for each sub period were plugged back into Fama-French 3-factor model to calculate weekly adjusted returns for each sub period.

4.13 Descriptive Summary of Integrated Method 1's Betas (Panel B)

Period/Country	AG	BR	CL	CN	CB	IN	ID	IS	MY	MX	PK	PE	PH	RS	SA	SL	TW	TH	TK	VN
2-Year Period																				
10/01/99-09/21/01	38	165	106	922	15	813	187	354	661	66	167	38	128	26	373	113	634	261	228	13
09/28/01-09/19/03	32	135	89	1125	17	766	168	284	673	64	149	36	90	43	268	108	816	247	261	5
09/26/03-09/16/05	31	131	86	1230	17	752	157	267	739	59	135	35	82	43	228	109	981	262	264	6
09/23/05-09/14/07	30	126	81	1194	16	750	145	283	837	57	136	34	82	44	212	115	1115	344	269	7
09/21/07-09/11/09	35	180	82	1282	15	834	128	356	788	60	36	32	91	80	239	116	1158	378	287	5
2.5-Year Period																				
10/01/99-03/22/02	35	148	101	918	12	761	179	327	654	66	155	37	119	25	338	110	618	255	228	11
03/29/02-09/17/04	31	134	86	1120	18	741	161	278	675	60	135	36	83	44	240	104	871	248	264	5
09/24/04-03/16/07	30	119	80	1238	14	735	140	270	776	58	131	34	82	37	211	110	1048	301	267	6
03/23/07-09/11/09	33	141	81	1225	14	798	121	320	777	59	36	29	83	74	218	116	1144	372	281	5
5-Year Period																				
10/01/99-09/17/04	29	124	85	854	12	658	129	235	594	55	131	33	80	21	226	102	568	234	221	5
09/24/04-09/11/09	29	101	71	1103	13	689	106	242	644	50	35	25	75	29	185	106	1001	281	256	5
10-Year Period																				
10/01/99-09/11/09	27	88	67	648	8	568	87	190	448	42	32	22	71	9	167	93	497	199	203	4

These integrated beta coefficients were calculated with weekly adjusted returns and TOTMKEK index. In order to adjust the weekly returns, ordinary excess returns, SMB, and HML for each 2-year, 2.5-year, 5-year, and 10-year sub period were plugged in Fama-French 3-factor model to calculate b_i, s_i, and h_i for 2-year, 2.5-year, 5-year, and 10-year sub period respectively. Then TOTMKEK index, SMB, HML, b_i, s_i, and h_i for each sub period were plugged back into Fama-French 3-factor model to calculate weekly adjusted returns for each sub period.

4.14 Descriptive Summary of Integrated Method 2's Betas (Panel B)

Period/Country	AG	BR	CL	CN	CB	IN	ID	IS	MY	MX	PK	PE	PH	RS	SA	SL	TW	TH	TK	VN
2-Year Period																				
10/01/99-09/21/01	38	165	106	922	15	813	187	354	661	66	167	38	128	26	373	113	634	261	228	13
09/28/01-09/19/03	32	135	89	1125	17	766	168	284	673	64	149	36	90	43	268	108	816	247	261	5
09/26/03-09/16/05	31	131	86	1230	17	752	157	267	739	59	135	35	82	43	228	109	981	262	264	6
09/23/05-09/14/07	30	126	81	1194	16	750	145	283	837	57	136	34	82	44	212	115	1115	344	269	7
09/21/07-09/11/09	35	180	82	1282	15	834	128	356	788	60	36	32	91	80	239	116	1158	378	287	5
2.5-Year Period																				
10/01/99-03/22/02	30	129	89	877	12	686	137	242	609	58	147	34	87	21	255	106	580	242	222	5
03/29/02-09/17/04	31	122	83	1080	16	713	140	257	641	56	131	34	81	39	219	102	764	228	257	5
09/24/04-03/16/07	30	114	76	1052	14	700	131	247	672	51	126	32	77	31	198	105	937	249	255	6
03/23/07-09/11/09	29	111	74	1120	14	716	112	262	719	53	36	26	78	36	192	112	1079	326	261	5
5-Year Period																				
10/01/99-09/17/04	29	117	83	836	12	638	118	222	578	52	129	32	78	19	207	100	546	223	218	5
09/24/04-09/11/09	29	99	69	984	13	668	100	229	575	47	34	25	73	25	182	102	906	236	247	5
10-Year Period																				
10/01/99-09/11/09	27	88	67	648	8	568	87	190	448	42	32	22	71	9	167	93	497	199	203	4

These integrated beta coefficients were calculated with weekly adjusted returns and TOTMKEK index. In order to adjust the weekly returns, ordinary excess returns, SMB, and HML for each 2-year sub period were plugged in Fama-French 3-factor model to calculate b_i, s_i, and h_i for 2-year sub period. Then TOTMKEK index, SMB, HML, b_i, s_i, and h_i for each sub period were plugged back into Fama-French 3-factor model to calculate weekly adjusted returns for each sub period.

4.15 Descriptive Summary of Integrated Method 1's Betas (Panel C)

Period	Min Beta	Stock Name	Country	Max Beta	Stock Name	Country
2-Year Period						
10/01/99-09/21/01	-6.373447	AVTOVAZ	Russia	4.374250	ADMIRAL LEIS.WLD. DEAD - 10/05/04 -	South Africa
09/28/01-09/19/03	-1.710537	SUMALINDO LESTARI JAYA	Indonesia	3.202532	MOULDED MED.SUPS. DEAD - 04/03/06 -	South Africa
09/26/03-09/16/05	-11.627394	BANFALC1	Peru	5.704654	ORIENT SEMICON.ELTN.	Taiwan
09/23/05-09/14/07	-5.536360	MELISRON	Israel	3.019392	HARVEST COURT	Malaysia
09/21/07-09/11/09	-58.913752	KUMPULAN JETSON	Malaysia	2.400126	TOPSPIN MEDICAL	Israel
2.5-Year Period						
10/01/99-03/22/02	-9.964726	DMCI HOLDINGS	Philippines	3.512822	ADMIRAL LEIS.WLD. DEAD - 10/05/04 -	South Africa
03/29/02-09/17/04	-3.979777	BOSCH FREN SIST.SANVETC.	Turkey	2.579851	AFRICAN MEDIA ENTM.	South Africa
09/24/04-03/16/07	-8.417157	BANFALC1	Peru	3.324096	ORIENT SEMICON.ELTN.	Taiwan
03/23/07-09/11/09	-57.381011	KUMPULAN JETSON	Malaysia	2.273967	TOPSPIN MEDICAL	Israel
5-Year Period						
10/01/99-09/17/04	-6.978802	DMCI HOLDINGS	Philippines	2.378190	SILICOM	Israel
09/24/04-09/11/09	-50.654591	KUMPULAN JETSON	Malaysia	1.990831	UNITECH	India
10-Year Period						
10/01/99-09/11/09	-33.005814	KUMPULAN JETSON	Malaysia	1.841773	GERDAU PN	Brazil

These integrated beta coefficients were calculated with weekly adjusted returns and TOTMKEK index. In order to adjust the weekly returns, ordinary excess returns, SMB, and HML for each 2-year, 2.5-year, 5-year, and 10-year sub period were plugged in Fama-French 3-factor model to calculate b_i, s_i, and h_i for 2-year, 2.5-year, 5-year, and 10-year sub period respectively. Then TOTMKEK index, SMB, HML, b_i, s_i, and h_i for each sub period were plugged back into Fama-French 3-factor model to calculate weekly adjusted returns for each sub period.

4.16 Descriptive Summary of Integrated Method 2's Betas (Panel C)

Period	Min Beta	Stock Name	Country	Max Beta	Stock Name	Country
2-Year Period						
10/01/99-09/21/01	-6.373447	AVTOVAZ	Russia	4.374250	ADMIRAL LEIS.WLD. DEAD - 10/05/04	South Africa
09/28/01-09/19/03	-1.710537	SUMALINDO LESTARI JAYA	Indonesia	3.202532	MOULDED MED.SUPS. DEAD - 04/03/06	South Africa
09/26/03-09/16/05	-11.627394	BANFALC1	Peru	5.704654	ORIENT SEMICON.ELTN.	Taiwan
09/23/05-09/14/07	-5.536360	MELISRON	Israel	3.019392	HARVEST COURT	Malaysia
09/21/07-09/11/09	-58.913752	KUMPULAN JETSON	Malaysia	2.400126	TOPSPIN MEDICAL	Israel
2.5Yrs Period						
10/01/99-03/22/02	-5.034277	AVTOVAZ	Russia	2.782664	NET HLDG.ANONIM SIRKETI	Turkey
03/29/02-09/17/04	-4.230575	BANFALC1	Peru	3.887300	ORIENT SEMICON.ELTN.	Taiwan
09/24/04-03/16/07	-3.865977	BANFALC1	Peru	2.435216	ORIENT SEMICON.ELTN.	Taiwan
03/23/07-09/11/09	-53.551645	KUMPULAN JETSON	Malaysia	2.250701	TOPSPIN MEDICAL	Israel
5Yrs Period						
10/01/99-09/17/04	-2.777064	AVTOVAZ	Russia	2.498581	ORIENT SEMICON.ELTN.	Taiwan
09/24/04-09/11/09	-43.671530	KUMPULAN JETSON	Malaysia	1.951038	UNITECH	India
10Yrs Period						
10/01/99-09/11/09	-29.604177	KUMPULAN JETSON	Malaysia	1.847836	GERDAU PN	Brazil

These integrated beta coefficients were calculated with weekly adjusted returns and TOTMKEK index. In order to adjust the weekly returns, ordinary excess returns, SMB, and HML for each 2-year sub period were plugged in Fama-French 3-factor model to calculate b_i, s_i, and h_i for 2-year sub period. Then TOTMKEK index, SMB, HML, b_i, s_i, and h_i for each sub period were plugged back into Fama-French 3-factor model to calculate weekly adjusted returns for each sub period.

4.5 Stabilitiy Test: Integrated Methods

Table 4.17 presents the transition matrix of multiple 2-year sub period betas for the first integrated method. The results indicated that 27-58 per cent of stocks with in extreme low risk class, 42-56 per cent of stocks in extreme high risk class, and 21-30 per cent of stocks in middle risk class tend to remain in the same risk class in the subsequent period. It was noticeable that the results of the first integrated method were the same as the results the single index model (as presented on table 4.1 in this chapter).

4.17 Transition Matrix of Integrated Method 1's Betas (2-Year Sub Period)

	Risk Class Period T+1 (09/28/01-09/19/03)					
Risk Class Period T (10/01/99-09/21/01)		1	2	3	4	5
	1	0.36	0.37	0.15	0.08	0.04
	2	0.29	0.29	0.24	0.13	0.04
	3	0.17	0.18	0.29	0.25	0.11
	4	0.11	0.10	0.23	0.31	0.25
	5	0.07	0.05	0.09	0.23	0.56
	Risk Class Period T+1 (09/26/03-09/16/05)					
Risk Class Period T (09/28/01-09/19/03)		1	2	3	4	5
	1	0.27	0.29	0.22	0.14	0.08
	2	0.24	0.31	0.24	0.13	0.07
	3	0.24	0.21	0.21	0.21	0.14
	4	0.18	0.12	0.20	0.25	0.26
	5	0.07	0.06	0.13	0.28	0.45
	Risk Class Period T+1 (09/23/05-09/14/07)					
Risk Class Period T (09/26/03-09/16/05)		1	2	3	4	5
	1	0.33	0.28	0.18	0.11	0.11
	2	0.34	0.28	0.16	0.13	0.09
	3	0.21	0.23	0.23	0.20	0.13
	4	0.09	0.14	0.26	0.27	0.24
	5	0.04	0.08	0.17	0.29	0.42
	Risk Class Period T+1 (09/21/07-09/11/09)					
Risk Class Period T (09/23/05-09/14/07)		1	2	3	4	5
	1	0.58	0.29	0.08	0.03	0.02
	2	0.26	0.32	0.24	0.12	0.06
	3	0.09	0.19	0.30	0.28	0.14
	4	0.04	0.13	0.23	0.32	0.27
	5	0.03	0.07	0.14	0.25	0.51

Table 4.18 presents the results for 2-year sub period for the second integrated method. These results were the same as the results of the first integrated method and the single index model. And thus the results of the descriptive summary for both integrated method for 2-year sub period which are presented on table 4.11 to table 4.16 were the same as the results of the single index model on table 3.1 to table 3.3. It could be concluded that both integrated methods did not reduce the instability of beta coefficients for 2-year sub period.

4.18 Transition Matrix of Integrated Method 2's Betas (2-Year Sub Period)

	Risk Class Period T+1 (09/28/01-09/19/03)					
Risk Class Period T (10/01/99-09/21/01)		1	2	3	4	5
	1	0.36	0.37	0.15	0.08	0.04
	2	0.29	0.29	0.24	0.13	0.04
	3	0.17	0.18	0.29	0.25	0.11
	4	0.11	0.10	0.23	0.31	0.25
	5	0.07	0.05	0.09	0.23	0.56
	Risk Class Period T+1 (09/26/03-09/16/05)					
Risk Class Period T (09/28/01-09/19/03)		1	2	3	4	5
	1	0.27	0.29	0.22	0.14	0.08
	2	0.24	0.31	0.24	0.13	0.07
	3	0.24	0.21	0.21	0.21	0.14
	4	0.18	0.12	0.20	0.25	0.26
	5	0.07	0.06	0.13	0.28	0.45
	Risk Class Period T+1 (09/23/05-09/14/07)					
Risk Class Period T (09/26/03-09/16/05)		1	2	3	4	5
	1	0.33	0.28	0.18	0.11	0.11
	2	0.34	0.28	0.16	0.13	0.09
	3	0.21	0.23	0.23	0.20	0.13
	4	0.09	0.14	0.26	0.27	0.24
	5	0.04	0.08	0.17	0.29	0.42
	Risk Class Period T+1 (09/21/07-09/11/09)					
Risk Class Period T (09/23/05-09/14/07)		1	2	3	4	5
	1	0.58	0.29	0.08	0.03	0.02
	2	0.26	0.32	0.24	0.12	0.06
	3	0.09	0.19	0.30	0.28	0.14
	4	0.04	0.13	0.23	0.32	0.27
	5	0.03	0.07	0.14	0.25	0.51

We repeated the transaction matrix technique for the 2.5-year sub period betas for both integrated methods. The results of the first integrated method on table 4.19 indicated that 44-47 per cent of stocks with in extreme low risk class; 34-59 per cent of stocks in extreme high risk class; and 22-31 per cent of stocks in middle risk class remained in the same risk class in the successive period. The results of the first integrated method were the same as the results of the single index model on table 4.2.

4.19 Transition Matrix of Integrated Method 1's Betas (2.5-Year Sub Period)

	Risk Class Period T+1 (03/29/02-09/17/04)					
Risk Class Period T (10/01/99-03/22/02)		1	2	3	4	5
	1	0.47	0.33	0.10	0.06	0.04
	2	0.26	0.31	0.23	0.14	0.07
	3	0.13	0.19	0.31	0.24	0.12
	4	0.09	0.11	0.23	0.33	0.24
	5	0.05	0.05	0.13	0.23	0.53
	Risk Class Period T+1 (09/24/04-03/16/07)					
Risk Class Period T (03/29/02-09/17/04)		1	2	3	4	5
	1	0.44	0.24	0.16	0.09	0.07
	2	0.32	0.27	0.18	0.12	0.11
	3	0.13	0.24	0.22	0.23	0.18
	4	0.07	0.15	0.24	0.23	0.31
	5	0.05	0.10	0.20	0.32	0.34
	Risk Class Period T+1 (03/23/07-09/11/09)					
Risk Class Period T (09/24/04-03/16/07)		1	2	3	4	5
	1	0.46	0.34	0.14	0.04	0.02
	2	0.28	0.32	0.23	0.12	0.04
	3	0.17	0.20	0.30	0.24	0.10
	4	0.07	0.10	0.23	0.36	0.24
	5	0.02	0.05	0.11	0.24	0.59

The results of 2.5-year sub period for the second integrated method were different from the results for the first integrate method and the single model. Table 4.20 indicated that 54-62 per cent of stocks with in extreme low risk class, 47-63 per cent of stocks in extreme high risk class, and 28-35 per cent of stocks in middle risk class remained in the same risk class in later period. The second integrated method seemed to increase the probability for the stocks in the highest, the lowest, and the middle risk class to remain in the same risk class in subsequent period.

4.20 Transition Matrix of Integrated Method 2's Betas (2.5-Year Sub Period)

	Risk Class Period T+1 (03/29/02-09/17/04)					
		1	2	3	4	5
Risk Class Period T (10/01/99-03/22/02)	1	0.54	0.32	0.08	0.05	0.02
	2	0.28	0.33	0.23	0.12	0.04
	3	0.11	0.22	0.33	0.25	0.10
	4	0.05	0.10	0.28	0.35	0.22
	5	0.02	0.03	0.08	0.24	0.63

	Risk Class Period T+1 (09/24/04-03/16/07)					
		1	2	3	4	5
Risk Class Period T (03/29/02-09/17/04)	1	0.56	0.24	0.12	0.06	0.02
	2	0.34	0.31	0.19	0.11	0.05
	3	0.07	0.27	0.28	0.22	0.16
	4	0.02	0.12	0.26	0.30	0.30
	5	0.01	0.05	0.15	0.31	0.47

	Risk Class Period T+1 (03/23/07-09/11/09)					
		1	2	3	4	5
Risk Class Period T (09/24/04-03/16/07)	1	0.62	0.29	0.06	0.02	0.01
	2	0.28	0.35	0.23	0.09	0.04
	3	0.06	0.21	0.35	0.25	0.12
	4	0.02	0.11	0.25	0.36	0.26
	5	0.01	0.04	0.11	0.28	0.57

Next we repeated transition matrix technique for both integrated methods for 5-year sub period. Table 4.21 and table 4.22 present the results for the first integrated method and the second integrated method respectively. The results for the lowest risk class stocks for both integrated methods were the same. Table 4.21 and table 4.22 indicated that 68 per cent of lowest risk class stocks for both integrated methods tend to remain in the same risk class in subsequent period. However the results of the middle and the highest risk classes of both methods were different. Table 4.21 indicated that 42 of highest risk class stocks and 30 per cent of middle risk class stocks remained in the same risk class in later period. While table 4.22 indicated that 44 of highest risk class stocks and 31 per cent of middle risk class stocks remained in the same risk class in later period.

In general, the results of these transition matrixes indicated; 1) the second integrated method could increased the number of the stocks remained in the lowest and the middle risk classes in subsequent periods for 2.5-year periods and 2) the second integrated method could increased the number of the stocks remained in the highest and the middle risk classes in subsequent periods for 5-year periods. However we still could not conclude whether the second method could increase the stability of the betas.

4.21 Transition Matrix of Integrated Method 1's Betas (5-Year Sub Period)

	Risk Class Period T+1 (09/24/04-09/11/09)					
Risk Class Period T (10/01/99-09/17/04)		1	2	3	4	5
	1	0.68	0.19	0.05	0.03	0.05
	2	0.22	0.34	0.19	0.15	0.10
	3	0.05	0.22	0.30	0.24	0.18
	4	0.03	0.16	0.26	0.29	0.26
	5	0.01	0.09	0.19	0.29	0.42

4.22 Transition Matrix of Integrated Method 2's Betas (5-Year Sub Period)

	Risk Class Period T+1 (09/24/04-09/11/09)					
Risk Class Period T (10/01/99-09/17/04)		1	2	3	4	5
	1	0.68	0.20	0.04	0.04	0.04
	2	0.23	0.33	0.20	0.14	0.10
	3	0.05	0.23	0.31	0.23	0.17
	4	0.04	0.16	0.26	0.30	0.25
	5	0.01	0.08	0.18	0.29	0.44

Table 4.23 to table 4.28 presents product moment and rank order correlation coefficients of integrated betas computed over 2-year, 2.5-year, and 5-year sub periods. According to the 2-year sub period results on table 4.23 and table 4.24, product moment of betas computed with both integrated methods continued to increase as the number of stocks per portfolio increased from 1 to 100. Rank order correlation coefficients of both integrated method increased toward 1.0 as the number of stock per portfolio increased. These results were the same as the result of the single index model on table 4.4.

For the 2.5-year sub period, the results for the first integrated method on table 4.25 were exactly the same as the results of the single index on table 4.5. While the results of the second integrated method on table 4.26 were different. Table 4.25

indicated that product moments of the first integrated method increased as the number of stock per portfolio increased from 1 to 250 and decreased after number of stock per portfolio greater than 250. But the results of the second integrated method on table 4.26 indicated that product moments increased as the number of stock per portfolio increased from 1 to 75 and decreased after the number of stock per portfolio reached over 75. For every portfolio size, the product moments of the second integrated method were slightly higher than the first method.

Table 4.25 and table 4.26 indicated the same positive relationship between the number of stocks per portfolio and the rank order correlation coefficients of both integrated method and the single index model. Moreover, table 4.26 also indicated that rank order correlations of the second integrated methods were slightly higher than the first integrated method.

For the 5-year sub period, the results of the first integrated method on table 4.27 were the same as the result of the single index model on table 4.6. But the results of the second method on table 4.28 were not exactly the same. Despite the fact that product moments of both integrated methods increased as the number of stock per portfolio increased from 1 to 250 and decreased after number of stock per portfolio reach over 250. The product moments of the second integrated method were a bit higher than the first method for every portfolio size except the 500-stock portfolio. Rank order correlations of both integrated methods continued to increase as the size of portfolio increase from 1 to 250.

In summary, the second integrated method could increase the magnitude of product moment and rank order correlation coefficients for 2.5-year and 5-year sub periods. Thus, the rank order correlation coefficients of 500-stock portfolios of almost all periods for both integrated methods were equal or closed to 1.0. The assessments of future betas are reliable for portfolios containing 500 stocks.

4.23 Product Moment & Rank Order Coefficients of Integrated Method 1's Betas (2-Year Sub Period)

No. of Stocks per Port	10/01/99-09/21/01 to	09/28/01-09/19/03	09/28/01-09/19/03 to	09/26/03-09/16/05	09/26/03-09/16/05 to	09/23/05-09/14/07	09/23/05-09/14/07 to	09/21/07-09/11/09
	P.M.	Rank	P.M.	Rank	P.M.	Rank	P.M.	Rank
1	0.491015	0.548712	0.349175	0.395528	0.364803	0.449274	0.209804	0.648743
2	0.598701	0.662312	0.460069	0.484488	0.481025	0.562089	0.290143	0.757946
4	0.705454	0.781573	0.590875	0.594391	0.596002	0.670476	0.391747	0.853203
7	0.765241	0.845268	0.699329	0.681317	0.678971	0.742534	0.493638	0.907981
10	0.791284	0.881240	0.751683	0.723602	0.740431	0.788847	0.556007	0.926195
20	0.851068	0.931298	0.834675	0.803201	0.817884	0.847076	0.682549	0.949725
35	0.874771	0.948261	0.878647	0.856280	0.875422	0.887199	0.764944	0.951523
50	0.893647	0.962303	0.887451	0.878986	0.876321	0.890416	0.811953	0.943553
75	0.918769	0.971103	0.906656	0.914623	0.891895	0.903004	0.856431	0.932730
100	0.922320	0.986166	0.905580	0.923776	0.901575	0.905158	0.873267	0.940735
250	0.908195	0.987616	0.903779	0.964912	0.882024	0.930827	0.895710	0.942857
500	0.878212	1.000000	0.858997	0.950000	0.840412	0.915152	0.863379	0.951515

4.24 Product Moment & Rank Order Coefficients of Integrated Method 2's Betas (2-Year Sub Period)

No. of Stocks per Port	10/01/99-09/21/01 to	09/28/01-09/19/03	09/28/01-09/19/03 to	09/26/03-09/16/05	09/26/03-09/16/05 to	09/23/05-09/14/07	09/23/05-09/14/07 to	09/21/07-09/11/09
	P.M.	Rank	P.M.	Rank	P.M.	Rank	P.M.	Rank
1	0.491015	0.548712	0.349175	0.395528	0.364803	0.449274	0.209804	0.648743
2	0.598701	0.662312	0.460069	0.484488	0.481025	0.562089	0.290143	0.757946
4	0.705454	0.781573	0.590875	0.594391	0.596002	0.670476	0.391747	0.853203
7	0.765241	0.845268	0.699329	0.681317	0.678971	0.742534	0.493638	0.907981
10	0.791284	0.881240	0.751683	0.723602	0.740431	0.788847	0.556007	0.926195
20	0.851068	0.931298	0.834675	0.803201	0.817884	0.847076	0.682549	0.949725
35	0.874771	0.948261	0.878647	0.856280	0.875422	0.887199	0.764944	0.951523
50	0.893647	0.962303	0.887451	0.878986	0.876321	0.890416	0.811953	0.943553
75	0.918769	0.971103	0.906656	0.914623	0.891895	0.903004	0.856431	0.932730
100	0.922320	0.986166	0.905580	0.923776	0.901575	0.905158	0.873267	0.940735
250	0.908195	0.987616	0.903779	0.964912	0.882024	0.930827	0.895710	0.942857
500	0.878212	1.000000	0.858997	0.950000	0.840412	0.915152	0.863379	0.951515

4.25 Product Moment & Rank Order Coefficients of Integrated Method 1's Betas (2.5-Year Sub Period)

No. of Stocks per Port	10/01/99-03/22/02 to 03/29/02-09/17/04		03/29/02-09/17/04 to 09/24/04-03/16/07		09/24/04-03/16/07 to 03/23/07-09/11/09	
	P.M.	Rank	P.M.	Rank	P.M.	Rank
1	0.449914	0.567792	0.392677	0.465686	0.216057	0.659013
2	0.559455	0.677474	0.510012	0.580900	0.298089	0.774377
4	0.652116	0.769583	0.628807	0.701594	0.403685	0.860740
7	0.712494	0.842200	0.713175	0.786612	0.502107	0.905510
10	0.747195	0.875427	0.758771	0.829204	0.574599	0.928335
20	0.814575	0.925229	0.832938	0.883152	0.698225	0.951525
35	0.846482	0.945696	0.864110	0.925346	0.784904	0.954087
50	0.878160	0.966738	0.875609	0.928459	0.816691	0.949055
75	0.886680	0.970716	0.892129	0.957692	0.856720	0.933634
100	0.892108	0.977046	0.894669	0.956470	0.871464	0.924706
250	0.912096	0.992647	0.882961	0.980702	0.894080	0.969925
500	0.863662	1.000000	0.847550	1.000000	0.869212	0.951515

4.26 Product Moment & Rank Order Coefficients of Integrated Method 2's Betas (2.5-Year Sub Period)

No. of Stocks per Port	10/01/99-03/22/02 to 03/29/02-09/17/04		03/29/02-09/17/04 to 09/24/04-03/16/07		09/24/04-03/16/07 to 03/23/07-09/11/09	
	P.M.	Rank	P.M.	Rank	P.M.	Rank
1	0.632748	0.699814	0.613416	0.662303	0.251490	0.750757
2	0.733882	0.793947	0.728151	0.776334	0.344116	0.840003
4	0.814088	0.870381	0.813002	0.861188	0.458147	0.907143
7	0.856476	0.919318	0.861493	0.910980	0.566515	0.941736
10	0.871386	0.934165	0.883657	0.935126	0.631013	0.951774
20	0.911297	0.962045	0.910635	0.964234	0.747997	0.962440
35	0.927362	0.974922	0.915903	0.973943	0.820175	0.959348
50	0.938480	0.981958	0.924189	0.982681	0.854099	0.950002
75	0.942241	0.983322	0.923550	0.988775	0.881950	0.941460
100	0.942700	0.988818	0.922632	0.991173	0.896953	0.953006
250	0.923519	0.991176	0.897589	0.995872	0.894454	0.944272
500	0.868760	1.000000	0.850848	1.000000	0.861104	0.983333

4.27 Product Moment & Rank Order Coefficients of Integrated Method 1's Betas (5-Year Sub Period)

No. of Stocks per Port	10/01/99- 09/17/04 to	09/24/04- 09/11/09
	P.M.	Rank
1	0.165598	0.612506
2	0.233364	0.708985
4	0.319590	0.791054
7	0.404405	0.849063
10	0.458859	0.867104
20	0.579172	0.887770
35	0.683983	0.920309
50	0.742920	0.913409
75	0.795237	0.891212
100	0.806219	0.911383
250	0.835487	0.934066
500	0.808002	0.942857

4.28 Product Moment & Rank Order Coefficients of Integrated Method 2's Betas (5-Year Sub Period)

No. of Stocks per Port	10/01/99- 09/17/04 to	09/24/04- 09/11/09
	P.M.	Rank
1	0.201011	0.624112
2	0.276363	0.718482
4	0.374730	0.804908
7	0.466794	0.860919
10	0.526941	0.877971
20	0.647899	0.910196
35	0.741466	0.919184
50	0.781311	0.912678
75	0.824516	0.917730
100	0.832800	0.917189
250	0.841230	0.945055
500	0.807698	0.942857

The estimated betas of 500-stock portfolios in 2 successive periods of 2-year, 2.5-year, and 5-year sub periods are presented in table 4.29 to table 4.34. The results of the first integrated method for 2-year, 2.5-year, and 5-year sub periods are presented in table 4.29, 4.31, and 3.33 respectively. Again, the results of the first integrated method were exactly the same as the results of the single index model in table 4.7 to table 4.8.

4.29 Estimated Integrated Method 1's Betas of 500-Stock Port in 2-Successive Period (2-Year Sub Period)

Port No.	10/01/99-09/21/01	09/28/01-09/19/03	09/28/01-09/19/03	09/26/03-09/16/05	09/26/03-09/16/05	09/23/05-09/14/07	09/23/05-09/14/07	09/21/07-09/11/09
1	-0.253086	0.230851	-0.113058	0.458839	-0.151295	0.415191	-0.187100	0.138243
2	0.030901	0.276904	0.120692	0.448955	0.220928	0.448202	0.134266	0.197661
3	0.168069	0.308552	0.203236	0.454018	0.337170	0.427722	0.291264	0.303237
4	0.302472	0.396828	0.287074	0.514328	0.426684	0.413523	0.424063	0.290188
5	0.433551	0.494863	0.387625	0.538883	0.521682	0.500387	0.535800	0.519254
6	0.579565	0.536190	0.518428	0.585550	0.626117	0.571113	0.636484	0.588212
7	0.746023	0.678310	0.674400	0.635932	0.743322	0.691443	0.735422	0.665962
8	1.012650	0.862214	0.865203	0.755986	0.893266	0.758202	0.844672	0.732386
9	1.683290	1.149387	1.129024	0.838023	1.073091	0.852315	0.975636	0.664992
10					1.370032	0.979808	1.168973	0.874746

4.30 Estimated Integrated Method 2's Betas of 500-Stock Port in 2-Successive Period (2-Year Sub Period)

Port No.	10/01/99-09/21/01	09/28/01-09/19/03	09/28/01-09/19/03	09/26/03-09/16/05	09/26/03-09/16/05	09/23/05-09/14/07	09/23/05-09/14/07	09/21/07-09/11/09
1	-0.253086	0.230851	-0.113058	0.458839	-0.151295	0.415191	-0.187100	0.138243
2	0.030901	0.276904	0.120692	0.448955	0.220928	0.448202	0.134266	0.197661
3	0.168069	0.308552	0.203236	0.454018	0.337170	0.427722	0.291264	0.303237
4	0.302472	0.396828	0.287074	0.514328	0.426684	0.413523	0.424063	0.290188
5	0.433551	0.494863	0.387625	0.538883	0.521682	0.500387	0.535800	0.519254
6	0.579565	0.536190	0.518428	0.585550	0.626117	0.571113	0.636484	0.588212
7	0.746023	0.678310	0.674400	0.635932	0.743322	0.691443	0.735422	0.665962
8	1.012650	0.862214	0.865203	0.755986	0.893266	0.758202	0.844672	0.732386
9	1.683290	1.149387	1.129024	0.838023	1.073091	0.852315	0.975636	0.664992
10					1.370032	0.979808	1.168973	0.874746

For the second integrated method, the results for 2-year, 2.5-year, and 5-year sub periods are presented in table 4.30, 4.32, and 3.34 respectively. The 2-year sub period results of the second integrated method were similar to those of the first integrated method and the single index model. The results of the 2.5-year and 5-year sub periods for the second were different in term of the magnitude of estimated betas in 2-succesive periods.

In general, the results of both integrated methods indicated that small risk portfolios tend to have higher risk in subsequent periods. While high risk portfolios tend to have lower risk in subsequent periods.

4.31 Estimated Integrated Method 1's Betas of 500-Stock Port in 2-Successive Period (2.5-Year Sub Period)

Port No.	10/01/99-03/22/02	03/29/02-09/17/04	03/29/02-09/17/04	09/24/04-03/16/07	09/24/04-03/16/07	03/23/07-09/11/09
1	-0.189753	0.251582	-0.076732	0.296254	-0.117561	0.212881
2	0.083218	0.285742	0.154468	0.333255	0.174080	0.271592
3	0.212080	0.365231	0.250589	0.400533	0.304041	0.206065
4	0.342763	0.513414	0.360206	0.496386	0.405976	0.427523
5	0.472405	0.554567	0.491576	0.586331	0.509395	0.461988
6	0.619556	0.626937	0.626573	0.697158	0.615547	0.580326
7	0.791568	0.734847	0.771518	0.768133	0.730408	0.663594
8	1.160361	0.933407	0.953658	0.789780	0.856686	0.643062
9			1.202593	0.793725	1.025800	0.861099
10					1.367021	1.049725

4.32 Estimated Integrated Method 2's Betas of 500-Stock Port in 2-Successive Period (2.5-Year Sub Period)

Port No.	10/01/99-03/22/02	03/29/02-09/17/04	03/29/02-09/17/04	09/24/04-03/16/07	09/24/04-03/16/07	03/23/07-09/11/09
1	-0.158796	0.214730	0.007009	0.220814	-0.053813	0.135782
2	0.085763	0.252234	0.190773	0.292815	0.224481	0.204248
3	0.214302	0.364099	0.279320	0.381120	0.370259	0.215607
4	0.351277	0.459275	0.386155	0.518725	0.496434	0.453309
5	0.491140	0.550455	0.511844	0.645442	0.609399	0.583661
6	0.645504	0.619500	0.657207	0.744583	0.715925	0.677586
7	0.842168	0.776468	0.824894	0.827176	0.831040	0.751217
8	1.302633	1.074427	1.041465	0.928860	0.969160	0.750364
9			1.421030	0.975962	1.191530	0.982776

4.33 Estimated Integrated Method 1's Betas of 500-Stock Port in 2-Successive Period (5-Year Sub Period)

Port No.	10/01/99-09/17/04	09/24/04-09/11/09
1	-0.022072	0.215871
2	0.205333	0.327574
3	0.378267	0.455800
4	0.532303	0.673063
5	0.697767	0.637340
6	0.951738	0.796731

4.34 Estimated Integrated Method 2's Betas of 500-Stock Port in 2-Successive Period (5-Year Sub Period)

Port No.	10/01/99-09/17/04	09/24/04-09/11/09
1	-0.006581	0.219420
2	0.195820	0.310159
3	0.361840	0.474603
4	0.507711	0.671211
5	0.671094	0.646602
6	0.925646	0.806721

4.6 Prediction Power

Traditionally, mean squared errors of the actual and the predicted betas were used to compare the effectiveness of the adjustment methods for the previous empirical studies. Due to the fact that one of the models for our study (Fama-French 3-factor) yields multiple betas, while the other models yield a single beta for each stock during each sub period. It would be impractical for us to compare the power of such model with other models by comparing any of betas or all of betas of that model with the single betas of others.

Hence, in order to compare the prediction power of all models, we will focus on the mean squared errors of the actual and the predicted returns instead. And since Blume's technique use the regression coefficients of the 2 consecutive periods to adjust betas, the MSE base on the actual and the predicted returns for the first sub period of every sub period length for Blume's technique are not available for all tables. Table 4.35-4.38 present mean square errors of actual returns and predicted returns for N-stock portfolios. We calculated MSE with the equation as follow.

$$MSE \; = \; \sum_{i=1}^{n}(A_i - P_i)^{\,2} \tag{9}$$

where A_i = actual return for stock i^{th}

P_i = predicted return for stock i^{th}

The results of the 2-year sub period in table 4.35 indicated that Vasicek's Bayesian approach outperformed the other method for the first and the fifth sub periods for all portfolio sizes. Integrated method 1 and 2 outperformed the other methods for the second and the third 2-year sub periods for every sized portfolio. For the third 2-year sub period, both integrated method could outperformed the other methods for almost all portfolio sizes, except the 1,000-stock portfolio.

Table 4.36 presents the results of the 2.5-year sub period. The results indicated that Vasicek's approach outperform the other methods for all portfolio sizes for first and fourth 2.5-year sub period. Blume's adjustment technique worked for the second 2.5-year sub period for all N-stock portfolios. Fama-French 3-factor outperformed the other methods in the third 2.5-year sub period.

According to the results of the 5-year sub period in table 4.37, Vasicek's approach outperformed the other methods for the first 5-year sub period for almost all portfolio sizes. However, the number of stocks per portfolios were greater than 250, the second integrated method outperformed Vasicek's approach. Table 4.38 presents the results for the 10-year sub period. Again, the results which indicated that Vasicek's approach won over the other methods for all N-stock portfolios.

In general, these results indicated MSE of returns predicted with Vasicek's Bayesian were lower than returns predicted with other adjustment approach for almost all sub period lengths. The two integrated method only worked for 2-year sub period length. These results also indicated poor performance of Blume's adjustment technique and Fama-French 3-factor model.

4.35 Forecast Errors Actual Returns and Predicted Returns (2-Year Sub Period)

	No. of Securities per Port												
	1	2	4	7	10	20	35	50	75	100	250	500	1000
Period 1 : 10/01/99-03/22/02													
Unadjusted	0.01419602	0.01419602	0.01419602	0.01414225	0.01413049	0.01413049	0.01396285	0.01396285	0.01366553	0.01366553	0.01366553	0.01366553	0.01219842
Blume's	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vasicek's	0.01338072	0.01338072	0.01338072	0.01335332	0.01335281	0.01335281	0.01322950	0.01322950	0.01305684	0.01305684	0.01305684	0.01305684	0.01198585
FF's	0.01599431	0.01599431	0.01599431	0.01594021	0.01592905	0.01592905	0.01576198	0.01576198	0.01547030	0.01547030	0.01547030	0.01547030	0.01422145
Integrated1	0.01419602	0.01419602	0.01419602	0.01414225	0.01413049	0.01413049	0.01396285	0.01396285	0.01366553	0.01366553	0.01366553	0.01366553	0.01219842
Integrated2	0.01419602	0.01419602	0.01419602	0.01414225	0.01413049	0.01413049	0.01396285	0.01396285	0.01366553	0.01366553	0.01366553	0.01366553	0.01219842
Period 2 : 09/28/01-09/19/03													
Unadjusted	0.00453894	0.00453894	0.00454097	0.00453894	0.00454097	0.00454097	0.00452721	0.00452337	0.00452337	0.00452337	0.00463775	0.00463775	0.00463775
Blume's	0.00453815	0.00453815	0.00454018	0.00453815	0.00454018	0.00454018	0.00452630	0.00452235	0.00452235	0.00452235	0.00463637	0.00463637	0.00463637
Vasicek's	0.00453818	0.00453818	0.00454021	0.00453818	0.00454021	0.00454021	0.00452632	0.00452236	0.00452236	0.00452236	0.00463638	0.00463638	0.00463638
FF's	0.00469701	0.00469701	0.00469913	0.00469701	0.00469913	0.00469913	0.00468804	0.00468772	0.00468772	0.00468772	0.00481266	0.00481266	0.00481266
Integrated1	0.00443921	0.00443995	0.00443787	0.00443995	0.00442215	0.00442942	0.00442630	0.00443405	0.00443405	0.00444768	0.00444264	0.00451014	0.00436070
Integrated2	0.00443921	0.00443995	0.00443787	0.00443995	0.00442215	0.00442942	0.00442630	0.00443405	0.00443405	0.00444768	0.00444264	0.00451014	0.00436070
Period 3 : 09/26/03-09/16/05													
Unadjusted	0.00609510	0.00609510	0.00609716	0.00609510	0.00609716	0.00609716	0.00608774	0.00609415	0.00609415	0.00609415	0.00609415	0.00609415	0.00612240
Blume's	0.00602846	0.00602846	0.00603067	0.00602846	0.00603067	0.00603067	0.00602144	0.00602941	0.00602941	0.00602941	0.00602941	0.00602941	0.00607292
Vasicek's	0.00599635	0.00599635	0.00599852	0.00599635	0.00599852	0.00599852	0.00598918	0.00599695	0.00599695	0.00599695	0.00599695	0.00599695	0.00603606
FF's	0.00789810	0.00789810	0.00790129	0.00789810	0.00790129	0.00790129	0.00789385	0.00790511	0.00790511	0.00790511	0.00790511	0.00790511	0.00790174
Integrated1	0.00596458	0.00596458	0.00593582	0.00596458	0.00593582	0.00593582	0.00586252	0.00593582	0.00593582	0.00593582	0.00577934	0.00577934	0.00577934
Integrated2	0.00596458	0.00596458	0.00593582	0.00596458	0.00593582	0.00593582	0.00586252	0.00593582	0.00593582	0.00593582	0.00577934	0.00577934	0.00577934
Period 4 : 09/23/05-09/14/07													
Unadjusted	0.00524412	0.00524412	0.00524412	0.00524412	0.00524503	0.00524503	0.00525450	0.00522716	0.00523491	0.00522716	0.00510455	0.00510455	0.00506984
Blume's	0.00529176	0.00529176	0.00529176	0.00529176	0.00529401	0.00529401	0.00530270	0.00527191	0.00527663	0.00527191	0.00514084	0.00514084	0.00508255
Vasicek's	0.00527145	0.00527145	0.00527145	0.00527145	0.00527404	0.00527404	0.00528321	0.00525281	0.00525872	0.00525281	0.00512547	0.00512547	0.00507590
FF's	0.00525538	0.00525538	0.00525538	0.00525538	0.00525646	0.00525646	0.00526572	0.00523899	0.00524683	0.00523899	0.00511726	0.00511726	0.00508578
Integrated1	0.00506754	0.00506717	0.00506717	0.00506761	0.00506717	0.00506717	0.00506761	0.00507189	0.00505178	0.00504393	0.00503486	0.00507785	0.00507785
Integrated2	0.00506754	0.00506717	0.00506717	0.00506761	0.00506717	0.00506717	0.00506761	0.00507189	0.00505178	0.00504393	0.00503486	0.00507785	0.00507785
Period 5 : 09/21/07-09/11/09													
Unadjusted	0.00830499	0.00830572	0.00830572	0.00831177	0.00830572	0.00830572	0.00831177	0.00831846	0.00834083	0.00834984	0.00840390	0.00846443	0.00846443
Blume's	0.00602552	0.00602604	0.00602604	0.00603060	0.00602604	0.00602604	0.00603060	0.00603585	0.00604945	0.00605283	0.00609025	0.00605531	0.00605531
Vasicek's	0.00522780	0.00522796	0.00522796	0.00523114	0.00522796	0.00522796	0.00523114	0.00523495	0.00524288	0.00523736	0.00526186	0.00516582	0.00516582
FF's	0.01412802	0.01412988	0.01412988	0.01414118	0.01412988	0.01412988	0.01414118	0.01415320	0.01420282	0.01423880	0.01434828	0.01468478	0.01468478
Integrated1	0.00808395	0.00808395	0.00808148	0.00808199	0.00808148	0.00808148	0.00809755	0.00809795	0.00809795	0.00813448	0.00817571	0.00817571	0.00817571
Integrated2	0.00808395	0.00808395	0.00808148	0.00808199	0.00808148	0.00808148	0.00809755	0.00809795	0.00809795	0.00813448	0.00817571	0.00817571	0.00817571

4.36 Forecast Errors Actual Returns and Predicted Returns (2.5-Year Sub Period)

	No. of Securities per Port												
	1	**2**	**4**	**7**	**10**	**20**	**35**	**50**	**75**	**100**	**250**	**500**	**1000**
Period 1 : 10/01/99-03/22/02													
Unadjusted	0.00548360	0.00548360	0.00548360	0.00548360	0.00548537	0.00549474	0.00549244	0.00548199	0.00548199	0.00550395	0.00548290	0.00541147	0.00541147
Blume's	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vasicek's	0.00545399	0.00545399	0.00545399	0.00545399	0.00545755	0.00546780	0.00546702	0.00545776	0.00545776	0.00548188	0.00546140	0.00539762	0.00539762
FF's	0.00781567	0.00781567	0.00781567	0.00781567	0.00782043	0.00783559	0.00783691	0.00783914	0.00783914	0.00788765	0.00789669	0.00798626	0.00798626
Integrated1	0.00548360	0.00548360	0.00548360	0.00548360	0.00548537	0.00549474	0.00549244	0.00548199	0.00548199	0.00550395	0.00548290	0.00541147	0.00541147
Integrated2	0.00537672	0.00537672	0.00537543	0.00537672	0.00537543	0.00537543	0.00537822	0.00539487	0.00539487	0.00539487	0.00541084	0.00541084	0.00541084
Period 2 : 03/29/02-09/17/04													
Unadjusted	0.00484386	0.00484491	0.00484724	0.00484724	0.00484491	0.00485041	0.00479882	0.00484491	0.00479633	0.00479633	0.00472035	0.00464671	0.00422954
Blume's	0.00466698	0.00466802	0.00467023	0.00467023	0.00466802	0.00467360	0.00462133	0.00466802	0.00461793	0.00461793	0.00454557	0.00450508	0.00414015
Vasicek's	0.00468120	0.00468224	0.00468445	0.00468445	0.00468224	0.00468815	0.00463638	0.00468224	0.00463294	0.00463294	0.00455882	0.00450408	0.00413972
FF's	0.00620246	0.00620359	0.00620579	0.00620579	0.00620359	0.00620883	0.00616277	0.00620359	0.00616985	0.00616985	0.00609973	0.00605030	0.00581318
Integrated1	0.00506177	0.00506177	0.00506177	0.00506041	0.00506036	0.00506036	0.00505548	0.00506036	0.00506036	0.00506036	0.00504656	0.00495992	0.00476749
Integrated2	0.00506862	0.00506862	0.00506951	0.00506862	0.00506951	0.00506951	0.00503464	0.00503094	0.00503094	0.00503094	0.00503094	0.00503094	0.00492778
Period 3 : 09/24/04-03/16/07													
Unadjusted	0.00716650	0.00716650	0.00716650	0.00716576	0.00715125	0.00715125	0.00711550	0.00710012	0.00710012	0.00710012	0.00711823	0.00711823	0.00711823
Blume's	0.00713076	0.00713076	0.00713076	0.00713034	0.00711754	0.00711754	0.00708235	0.00707000	0.00707000	0.00707000	0.00709686	0.00709686	0.00709686
Vasicek's	0.00713482	0.00713482	0.00713482	0.00713427	0.00712204	0.00712204	0.00708693	0.00707365	0.00707365	0.00707365	0.00709778	0.00709778	0.00709778
FF's	0.00631780	0.00631780	0.00631780	0.00631637	0.00630521	0.00630521	0.00626092	0.00623554	0.00623554	0.00623554	0.00617530	0.00617530	0.00617530
Integrated1	0.00712793	0.00712793	0.00711995	0.00712010	0.00712010	0.00712010	0.00712010	0.00704551	0.00708255	0.00704551	0.00704551	0.00704551	0.00704551
Integrated2	0.00707570	0.00707570	0.00707570	0.00707570	0.00694061	0.00694061	0.00672658	0.00666290	0.00661788	0.00666290	0.00647813	0.00647813	0.00613704
Period 4 : 03/23/07-09/11/09													
Unadjusted	0.00785815	0.00785815	0.00785828	0.00786297	0.00786297	0.00786297	0.00786297	0.00788861	0.00787576	0.00788861	0.00788861	0.00788861	0.00788861
Blume's	0.00569092	0.00569092	0.00569006	0.00569400	0.00569400	0.00569400	0.00569400	0.00570617	0.00570190	0.00570617	0.00570617	0.00570617	0.00570617
Vasicek's	0.00475283	0.00475283	0.00475173	0.00475397	0.00475397	0.00475397	0.00475397	0.00475478	0.00475751	0.00475478	0.00475478	0.00475478	0.00475478
FF's	0.01034708	0.01034708	0.01034841	0.01035551	0.01035551	0.01035551	0.01035551	0.01040182	0.01037604	0.01040182	0.01040182	0.01040182	0.01040182
Integrated1	0.00800284	0.00800106	0.00800197	0.00800240	0.00800451	0.00800451	0.00800954	0.00802041	0.00800062	0.00802041	0.00812053	0.00830227	0.00873134
Integrated2	0.00777469	0.00777274	0.00777274	0.00777669	0.00777274	0.00777274	0.00777669	0.00778248	0.00779870	0.00782154	0.00784920	0.00802400	0.00802400

4.37 Forecast Errors Actual Returns and Predicted Returns (5-Year Sub Period)

	No. of Securities per Port												
	1	2	4	7	10	20	35	50	75	100	250	500	1000
Period 1 : 10/01/99-09/17/04													
Unadjusted	0.00477815	0.00477815	0.00477555	0.00477702	0.00477815	0.00477433	0.00477702	0.00476816	0.00476816	0.00476593	0.00473769	0.00473384	0.00473384
Blume's	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vasicek's	0.00471271	0.00471271	0.00471215	0.00471447	0.00471271	0.00471343	0.00471447	0.00471082	0.00471082	0.00470142	0.00467762	0.00467487	0.00467487
FF's	0.00600211	0.00600211	0.00600235	0.00600362	0.00600211	0.00600343	0.00600362	0.00599478	0.00599478	0.00599793	0.00602317	0.00608275	0.00608275
Integrated1	0.00477815	0.00477815	0.00477555	0.00477702	0.00477815	0.00477433	0.00477702	0.00476816	0.00476816	0.00476593	0.00473769	0.00473384	0.00473384
Integrated2	0.00474385	0.00474385	0.00474147	0.00474396	0.00474385	0.00474244	0.00474396	0.00474861	0.00474861	0.00468556	0.00467803	0.00456600	0.00456600
Period 2 : 09/24/04-09/11/09													
Unadjusted	0.00806697	0.00806697	0.00807035	0.00807344	0.00806697	0.00808189	0.00807344	0.00807161	0.00807161	0.00813560	0.00825033	0.00856039	0.00856039
Blume's	0.00500789	0.00500789	0.00500989	0.00500941	0.00500789	0.00501265	0.00500941	0.00499147	0.00499147	0.00501988	0.00500733	0.00506055	0.00506055
Vasicek's	0.00450390	0.00450390	0.00450524	0.00450524	0.00450390	0.00450852	0.00450524	0.00448786	0.00448786	0.00449875	0.00444606	0.00443990	0.00443990
FF's	0.00771882	0.00771882	0.00772252	0.00772548	0.00771882	0.00773337	0.00772548	0.00772259	0.00772259	0.00777991	0.00788206	0.00816930	0.00816930
Integrated1	0.00717280	0.00717280	0.00717484	0.00717880	0.00717880	0.00717880	0.00717880	0.00720817	0.00718647	0.00720817	0.00720817	0.00720817	0.00720817
Integrated2	0.00670639	0.00670639	0.00670639	0.00670639	0.00671501	0.00671501	0.00672495	0.00674387	0.00676137	0.00674387	0.00679920	0.00679920	0.00718606

4.38 Forecast Errors Actual Returns and Predicted Returns (10-Year Sub Period)

	No. of Securities per Port												
	1	2	4	7	10	20	35	50	75	100	250	500	1000
Period 1 : 10/01/99-09/11/09													
Unadjusted	0.00606303	0.00606303	0.00606579	0.00606883	0.00606303	0.00607167	0.00606883	0.00607722	0.00607722	0.00611279	0.00620186	0.00637625	0.00637625
Blume's	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vasicek's	0.00443730	0.00443730	0.00443915	0.00444085	0.00443730	0.00444156	0.00444085	0.00444272	0.00444272	0.00445484	0.00446862	0.00450149	0.00450149
FF's	0.00564653	0.00564653	0.00564915	0.00565195	0.00564653	0.00565408	0.00565195	0.00565849	0.00565849	0.00569084	0.00575652	0.00589517	0.00589517
Integrated1	0.00606303	0.00606303	0.00606579	0.00606883	0.00606303	0.00607167	0.00606883	0.00607722	0.00607722	0.00611279	0.00620186	0.00637626	0.00637626
Integrated2	0.00577219	0.00577219	0.00577478	0.00577759	0.00577219	0.00577987	0.00577759	0.00578438	0.00578438	0.00581534	0.00589773	0.00602733	0.00602733

CHAPTER V
CONCLUSION

This research explores the issue of beta stationarity on Emerging Markets. Our results confirm the results of previous empirical studies over the stationarity issue. The results indicate that the stationarity of beta has a positive relationship with length of the estimation period and portfolio size. Longer estimation period increase the stability of the betas calculated with single index. The analysis on portfolios indicates that beta stability increases as the portfolio size increases. The transition matrices illustrated that betas do not tend to stay in the same risk class in the subsequent periods.

In order to seek for alternative method to alleviate the stationarity issue. This study proposes two integrated beta adjustment methods by combining Fama-French 3-factor model and original single index model. The stability tests used for single index model are repeated on both integrated methods. For the second integrated method, transition matrices indicate the increased tendency of lowest and highest risk betas to remain in their risk class in the later period. However, the overall results indicate that the both integrated beta adjustment methods do not significantly improve the beta stationarity.

Comparing the prediction power of each model, it is noticeable that the two integrated methods increase the prediction power over the short sub periods. Both integrated methods improve the prediction power of betas in two out of five 2-year sub periods. Our results strongly indicate that Vasicek's adjustment techniques outperform the other methods in three out of four sub period lengths (2.5-year, 5-year, and 10-year sub periods). Fama-French 3-factor model is unable to explain the returns of Emerging Markets on all sub periods, except for third 2.5 sub period. Blume's method does not significantly increase the prediction power of beta for Emerging Markets. Blume's method underperforms other methods on all sub periods, except for second 2.5 sub period.

In conclusion, we believe the investors will be better off using Vasicek's adjustment technique or any of the two integrated methods with a combination of reasonable estimation period and portfolio size to forecast investment returns in Emerging Markets more accurately.

For further study, there are numbers of related study areas which focus on the beta stationarity issue and its explanatory power. Among these studies, we believe the studies in the following areas should be pursued:

1. The Unit Root Test such as Dickey-Fuller Test and Phillips-Perron Test – to test the stability of the time series data
2. The Methods to Transform Non-stationary Time Series such as Difference Stationary Process and Trend-Stationary Process – to make the time series stable before use in order to avoid the spurious regression from
3. Cointegration Method – to make the time series stable by regressing non-stationary time series on another non-stationary time series

We believe if the stationary issue is fixed at the input level, the output will be more accurate. That is if the time series data is stable, the prediction power of the model will be increased.

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APPENDIX

BRIC Coverage

Market	No. of Stocks before Screen-ing	No. of Valid Stocks (Continously Trade Stocks with ME and BE/ME Ratios)										
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	10 Year Period
Argentina	147	45	35	29	28	27	27	26	26	25	25	25
Brazil	598	185	148	128	122	117	110	102	96	88	85	85
Chile	300	115	96	87	82	79	77	72	69	65	63	63
China	1,819	894	887	873	851	829	811	753	676	636	626	626
Colombia	166	16	15	12	12	12	12	9	9	9	8	8
India	2,323	287	278	269	256	249	246	238	232	229	227	227
Indonesia	466	177	155	130	117	112	101	94	91	87	77	77
Israel	871	63	58	56	55	54	53	52	50	49	48	48
Malaysia	1,181	444	432	419	405	394	385	373	343	326	309	309
Mexico	260	74	52	51	46	45	43	42	37	36	35	35
Pakistan	408	66	61	59	55	54	54	54	54	23	16	16
Peru	299	31	22	20	20	19	19	19	18	18	15	15
Philippines	275	118	103	86	71	67	65	65	61	59	59	59
Russia Federation	467	10	9	9	9	9	9	8	8	6	6	6
South Africa	926	433	351	279	237	209	191	180	170	160	157	157
Sri Lanka	285	19	19	19	18	18	18	18	18	18	17	17
Taiwan	1,542	367	358	345	325	322	315	305	294	285	283	283
Thailand	742	211	200	191	184	178	170	166	162	157	154	154
Turkey	370	124	114	114	113	112	110	109	108	106	106	106
Venezuela	83	14	12	10	5	5	5	5	5	4	4	4
BRIC Total	5,207	1,376	1,322	1,279	1,238	1,204	1,176	1,101	1,012	959	944	944
Total	13,528	3,693	3,405	3,186	3,011	2,911	2,821	2,690	2,527	2,386	2,320	2,320
BRIC Coverage	38.49%	37.26%	38.83%	40.14%	41.12%	41.36%	41.69%	40.93%	40.05%	40.19%	40.69%	40.69%

Chi Square for Transition Matrix of Estimated Betas

2-Year Sub Period

		Risk Class Period T+1 (09/28/01-09/19/03)				
Risk Class Period T (10/01/99-09/21/01)		1	2	3	4	5
	1	119.97	132.06	10.53	67.06	121.20
	2	38.00	40.08	6.45	20.05	111.44
	3	5.21	1.35	38.69	11.74	38.47
	4	34.75	46.87	3.79	51.05	13.32
	5	79.90	96.37	55.65	4.39	581.55
						1,729.93

		Risk Class Period T+1 (09/26/03-09/16/05)				
Risk Class Period T (09/28/01-09/19/03)		1	2	3	4	5
	1	25.17	40.46	2.68	20.50	72.03
	2	9.66	63.79	8.07	24.52	80.68
	3	6.91	0.87	0.27	0.26	21.04
	4	2.43	30.45	0.07	10.10	17.38
	5	84.54	95.26	22.36	33.58	319.88
						992.95

		Risk Class Period T+1 (09/23/05-09/14/07)				
Risk Class Period T (09/26/03-09/16/05)		1	2	3	4	5
	1	84.93	30.52	3.13	44.30	39.90
	2	95.93	32.28	9.52	23.27	57.24
	3	0.56	3.82	5.24	0.02	23.50
	4	64.89	20.02	20.65	27.68	7.42
	5	136.98	75.44	3.92	40.51	256.08
						1,107.74

		Risk Class Period T+1 (09/21/07-09/11/09)				
Risk Class Period T (09/23/05-09/14/07)		1	2	3	4	5
	1	767.60	39.18	71.16	151.75	174.42
	2	21.34	71.31	8.79	33.99	104.07
	3	65.51	0.43	56.59	30.91	18.83
	4	136.99	23.09	6.19	76.00	28.12
	5	156.84	85.47	20.65	14.97	503.85
						2,668.06

2.5-Year Sub Period

		Risk Class Period T+1 (03/29/02-09/17/04)				
Risk Class Period T (10/01/99-03/22/02)		1	2	3	4	5
	1	320.23	72.96	40.06	89.98	112.73
	2	14.36	53.80	3.85	17.69	78.90
	3	19.09	0.20	52.14	7.80	27.03
	4	57.76	33.52	4.47	74.25	7.07
	5	94.33	92.87	24.73	5.20	485.91
						1,790.93

		Risk Class Period T+1 (09/24/04-03/16/07)				
Risk Class Period T (03/29/02-09/17/04)		1	2	3	4	5
	1	268.94	9.49	7.69	54.41	87.10
	2	63.76	26.19	1.93	27.80	41.45
	3	20.94	6.27	2.19	4.00	1.97
	4	82.93	12.54	8.21	5.30	55.95
	5	114.54	51.26	0.03	69.64	94.01
						1118.55

		Risk Class Period T+1 (03/23/07-09/11/09)				
Risk Class Period T (09/24/04-03/16/07)		1	2	3	4	5
	1	346.07	96.09	20.26	126.50	160.16
	2	36.01	75.28	4.47	29.97	128.09
	3	6.05	0.12	50.30	6.43	46.55
	4	82.17	53.36	4.18	124.11	10.14
	5	171.03	117.18	45.59	9.27	762.55
						2,511.94

5-Year Sub Period

		Risk Class Period T+1 (09/24/04-09/11/09)				
Risk Class Period T (10/01/99-09/17/04)		1	2	3	4	5
	1	804.68	0.24	79.13	99.98	80.65
	2	1.66	69.48	0.10	10.29	37.14
	3	77.63	1.89	36.52	6.57	1.37
	4	94.95	6.40	14.08	26.11	11.64
	5	123.26	44.74	0.33	30.63	164.71
						1,824.18

Chi Square for Transition Matrix of Integrated Method 1's Betas

2-Year Sub Period

Risk Class Period T (10/01/99-09/21/01)	Risk Class Period T+1 (09/28/01-09/19/03)				
	1	2	3	4	5
1	119.97	132.06	10.53	67.06	121.20
2	38.00	40.08	6.45	20.05	111.44
3	5.21	1.35	38.69	11.74	38.47
4	34.75	46.87	3.79	51.05	13.32
5	79.90	96.37	55.65	4.39	581.55
					1,729.93

Risk Class Period T (09/28/01-09/19/03)	Risk Class Period T+1 (09/26/03-09/16/05)				
	1	2	3	4	5
1	25.17	40.46	2.68	20.50	72.03
2	9.66	63.79	8.07	24.52	80.68
3	6.91	0.87	0.27	0.26	21.04
4	2.43	30.45	0.07	10.10	17.38
5	84.54	95.26	22.36	33.58	319.88
					992.95

Risk Class Period T (09/26/03-09/16/05)	Risk Class Period T+1 (09/23/05-09/14/07)				
	1	2	3	4	5
1	84.93	30.52	3.13	44.30	39.90
2	95.93	32.28	9.52	23.27	57.24
3	0.56	3.82	5.24	0.02	23.50
4	64.89	20.02	20.65	27.68	7.42
5	136.98	75.44	3.92	40.51	256.08
					1,107.74

Risk Class Period T (09/23/05-09/14/07)	Risk Class Period T+1 (09/21/07-09/11/09)				
	1	2	3	4	5
1	767.60	39.18	71.16	151.75	174.42
2	21.34	71.31	8.79	33.99	104.07
3	65.51	0.43	56.59	30.91	18.83
4	136.99	23.09	6.19	76.00	28.12
5	156.84	85.47	20.65	14.97	503.85
					2,668.06

2.5-Year Sub Period

Risk Class Period T (10/01/99-03/22/02)	Risk Class Period T+1 (03/29/02-09/17/04)				
	1	2	3	4	5
1	320.23	72.96	40.06	89.98	112.73
2	14.36	53.80	3.85	17.69	78.90
3	19.09	0.20	52.14	7.80	27.03
4	57.76	33.52	4.47	74.25	7.07
5	94.33	92.87	24.73	5.20	485.91
					1,790.93

Risk Class Period T (03/29/02-09/17/04)	Risk Class Period T+1 (09/24/04-03/16/07)				
	1	2	3	4	5
1	268.94	9.49	7.69	54.41	87.10
2	63.76	26.19	1.93	27.80	41.45
3	20.94	6.27	2.19	4.00	1.97
4	82.93	12.54	8.21	5.30	55.95
5	114.54	51.26	0.03	69.64	94.01
					1118.55

Risk Class Period T (09/24/04-03/16/07)	Risk Class Period T+1 (03/23/07-09/11/09)				
	1	2	3	4	5
1	346.07	96.09	20.26	126.50	160.16
2	36.01	75.28	4.47	29.97	128.09
3	6.05	0.12	50.30	6.43	46.55
4	82.17	53.36	4.18	124.11	10.14
5	171.03	117.18	45.59	9.27	762.55
					2,511.94

5-Year Sub Period

Risk Class Period T (10/01/99-09/17/04)	Risk Class Period T+1 (09/24/04-09/11/09)				
	1	2	3	4	5
1	804.68	0.24	79.13	99.98	80.65
2	1.66	69.48	0.10	10.29	37.14
3	77.63	1.89	36.52	6.57	1.37
4	94.95	6.40	14.08	26.11	11.64
5	123.26	44.74	0.33	30.63	164.71
					1,824.18

Chi Square for Transition Matrix of Integrated Method 2's Betas

2-Year Sub Period

Risk Class Period T (10/01/99-09/21/01)	Risk Class Period T+1 (09/28/01-09/19/03)				
	1	2	3	4	5
1	119.97	132.06	10.53	67.06	121.20
2	38.00	40.08	6.45	20.05	111.44
3	5.21	1.35	38.69	11.74	38.47
4	34.75	46.87	3.79	51.05	13.32
5	79.90	96.37	55.65	4.39	581.55
					1,729.93

Risk Class Period T (09/28/01-09/19/03)	Risk Class Period T+1 (09/26/03-09/16/05)				
	1	2	3	4	5
1	25.17	40.46	2.68	20.50	72.03
2	9.66	63.79	8.07	24.52	80.68
3	6.91	0.87	0.27	0.26	21.04
4	2.43	30.45	0.07	10.10	17.38
5	84.54	95.26	22.36	33.58	319.88
					992.95

Risk Class Period T (09/26/03-09/16/05)	Risk Class Period T+1 (09/23/05-09/14/07)				
	1	2	3	4	5
1	84.93	30.52	3.13	44.30	39.90
2	95.93	32.28	9.52	23.27	57.24
3	0.56	3.82	5.24	0.02	23.50
4	64.89	20.02	20.65	27.68	7.42
5	136.98	75.44	3.92	40.51	256.08
					1,107.74

Risk Class Period T (09/23/05-09/14/07)	Risk Class Period T+1 (09/21/07-09/11/09)				
	1	2	3	4	5
1	767.60	39.18	71.16	151.75	174.42
2	21.34	71.31	8.79	33.99	104.07
3	65.51	0.43	56.59	30.91	18.83
4	136.99	23.09	6.19	76.00	28.12
5	156.84	85.47	20.65	14.97	503.85
					2,668.06

2.5-Year Sub Period

Risk Class Period T (10/01/99-03/22/02)	Risk Class Period T+1 (03/29/02-09/17/04)				
	1	2	3	4.00	5.00
1	480.76	60.44	62.00	100.68	139.03
2	29.10	71.31	3.47	27.15	110.14
3	37.30	1.97	70.70	9.56	46.22
4	96.11	39.49	26.67	92.07	1.76
5	130.12	128.57	57.26	6.53	770.81
					2,599.24

Risk Class Period T (03/29/02-09/17/04)	Risk Class Period T+1 (09/24/04-03/16/07)				
	1	2	3	4	5
1	578.30	8.88	32.57	87.64	142.93
2	86.47	58.44	0.92	34.56	102.11
3	76.68	22.70	28.91	2.23	8.30
4	144.92	30.33	18.65	42.64	44.85
5	157.52	97.65	9.18	52.09	332.90
					2,202.37

Risk Class Period T (09/24/04-03/16/07)	Risk Class Period T+1 (03/23/07-09/11/09)				
	1	2	3	4	5
1	838.14	39.90	93.75	157.09	170.42
2	32.00	104.53	5.21	52.44	119.24
3	88.16	0.79	108.24	11.94	28.70
4	146.25	40.46	11.94	120.08	16.35
5	172.34	122.47	41.69	28.76	639.35
					3,190.28

5-Year Sub Period

Risk Class Period T (10/01/99-09/17/04)	Risk Class Period T+1 (09/24/04-09/11/09)				
	1	2	3	4	5
1	790.30	0.00	85.28	86.86	91.67
2	3.24	57.32	0.00	13.82	32.15
3	82.18	3.88	44.06	4.22	2.55
4	91.67	6.83	12.23	33.51	8.43
5	127.06	48.21	0.84	26.98	194.25
					1,847.54

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