International Research Journal of Finance and Economics
ISSN 1450-2887 Issue 85 (2012)
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http://www.internationalresearchjournaloffinanceandeconomics.com

Sensitivity of Sector Risk-Return Relationships in the Saudi Arabian Stock Market

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Abstract

Since 2001 the development of the Saudi Arabian capital market has dramatically improved its technical infrastructure. The very nature of these new emerging markets necessitates the need for establishing a benchmark for future equity analysis. It is against this backdrop that this paper investigates the sensitivity of sector risk-return relationships in the Saudi Arabian Stock Market. Using the Capital Asset Pricing Model (CAPM), the beta and alpha coefficients are calculated and later refined with a rolling regression technique. Results suggest that beta is time variant. Using a static beta measurement without consideration to its relative daily instability, distorted sector-market relationship signals and lead to spurious results. This suggests one should not rely on the traditional beta measurement as a sole guiding investment tool. The contribution of this paper provides a more refined technique, a rolling beta, to accurately capture daily valuation swings caused by market-moving events over time. Subsequently alpha values were calculated using the CAPM and more accurate risk-return valuations were forecasted of future expected outcomes. More robust forecast results emerged identifying four key phases of varying stock market activity (systematic risk) and sector market valuations previously unrecognized when using a static beta model.

Keywords: Alpha, Beta Stability, CAPM, Rolling Beta Regression, Emerging Markets.
JEL Classification codes: G120, G140

1. Introduction

From early 2007 to late 2011, the Saudi Arabian stock market (Tadawul or TASI Index) was exposed to several turbulent market-moving events. Over this short period four distinct cycles related to financial, economic and political upheavals can be identified. Firstly, a boom in the TASI Index in 2007 and early 2008 took place, stirred by the dramatic increase in world oil prices. This was followed by the severe global financial and economic downturn in late 2008/early 2009 triggered by the momentous collapse of a number of global banking and financial institutions. A gradual resuscitation and recovery of international markets in 2010 associated with wide-spread Central Bank quantitative easing (QE1 and QE2) lead by the United States Federal Reserve is the third identified phase. The final phase in 2011 was a period dominated by unprecedented unrest across the Middle East (The Arab Spring), coupled with the debt ceiling fiasco in the United States and the uncertainty over the very

survival of both the Euro-currency and the EU zone. Against this backdrop this paper seeks to analyse the sensitivity of sector market risk-returns of the Saudi TASI Index.

A fundamental question in finance is how the risk of an investment should affect its expected return? Not all risks affect asset returns, some are diversified away. The remaining risk is market or systematic risk. This risk affects all firms and is unavoidable for investors. It can be caused by changes in long-term interest rates, inflation rates or other such macroeconomic shocks which can influence expected returns. It is therefore crucial for investors and financiers alike to understand the amount of unavoidable risk they are exposed to. One such indicator is the estimation of the coefficient beta, developed in the 1960s as a component of the Capital Asset Pricing Model (CAPM) by Sharpe (1964), Lintner (1965) and Mossin (1966). Beta provides a measurement of the risk-return sensitivity between a stock/sector and the overall market.The contribution of this research is to measure the sensitivity of sector market risk-returns by calculating the inter-temporal coefficients of beta and alpha based on the fifteen TASI sector returns and the TASI Index for the period April 2007 through to December 2011. The beta measurement is one of the most recognized and frequently used tools in the field of finance. The measurement of beta enables the required return to be calculated by investors, the cost of capital to be estimated by firms seeking finance, and provides a guide for fund managers in the composition of an appropriately diversified portfolio. Beta also enables the calculation of alpha (excess returns over the market) which is a key financial measurement used to benchmark portfolio performance. The incentive behind this research is driven by the fact that in well-established financial markets, beta is calculated and commonly made use of by financial analysts and academics for portfolio management decision making and performance measurement. However in the relatively new financial market of Saudi Arabia, the beta is not yet commonly used in financial reporting and analysis. The very nature of these new emerging markets necessitates the need for such calculations for greater transparency, improved efficient allocation of capital as well as establishing a benchmark for future equity analysis. It is against this backdrop that a series of research questions emerge concerning the impact of systematic risk and the sensitivity of each sectors' risk-return relationship to the broader TASI market over the period of 2007 to 2011. Is the beta coefficient stable within each sector over time? How plausible is the assumption that a low beta estimate signals a low risk investment strategy? Are sector returns over-valued or under-valued and are they time-variant?

The following section provides a brief background of the Saudi Arabia capital market. A literature review follows. Section four describes the data and methodologies used in this study. Section five reports the analysis and results. Finally, section six provides discussion and concluding observations.

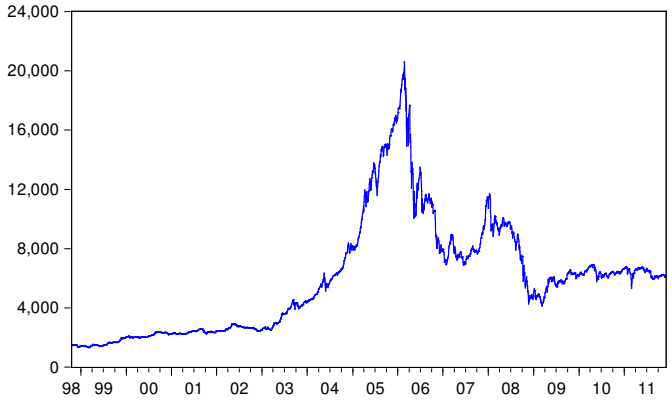
2. Background

Since 2001 the development of the Saudi capital market has dramatically improved its technical infrastructure. A greater variety and depth of financial product sophistication and choice has emerged together with improved regulatory supervision provided by the establishment of the Capital Market Authority (CMA) in 2003. The CMA provides a legal and regulatory framework designed to open up the Saudi capital market to support the government's stated goal of privatization, promote greater efficiency and transparency, and increase public participation in financial markets. Financial liberalization is evolving. The state-owned Tadawul Exchange was re-incorporated as a joint stock company in March 2007 with a capital of SAR1.2 billion to give the exchange greater autonomy. Between 2003 and 2007, Tadawul's total market capitalization was SAR 1.9 trillion. The impact of the Global Financial Crisis (GFC) in 2008 saw the market capitalization slide to SAR 924.5 billion before rising to SAR 1.2 trillion in 2009 (Oxford Business Group, 2010).

Figure 1 shows the returns of the TASI from 1998 to 2011. It reveals a staggering 700 per cent increase from 2003 until early 2006. Much of this increase was attributed to several structural rigidities in the market, corporate governance and transparency issues, as well as the dominance of small retail investors. By 2009 these small retail investors accounted for approximately 90 per cent of the buy

orders in the market, attracted by the many underpriced IPOs at the time. When the TASI peaked in 2006 it was the world's tenth largest stock market by value, despite having only 78 listed stocks (SAMBA Financial Group, 2009). The subsequent fall was just as sharp as the rise, with the TASI collapsing almost 80 per cent over the next 21 months.

Figure 1: The Tadawul All Share Index (TASI) 1998 – 2011.



By the end of September 2011 the Saudi Market had a market capitalization of SAR1.2 trillion. This accounts for approximately half of the market capitalization of the broader GCC region (Emirates 24/7, 2011). While the TASI is the largest in the GCC region, it remains a minor player in global terms. The market comprises of 149 companies spread across 15 different sectors. It is dominated by two sectors - the Petrochemical and the Banks and Financial Services sectors which account for more than 62.2 per cent of the total market capitalization.

3. Literature Review

In 1990, William Sharpe won a Nobel Prize in Economics for his work in developing the Capital Asset Pricing Model (CAPM). Traditionally the CAPM has been the basis for calculating the required return to the shareholder. In turn this figure has been used to calculate the economic value of the stock and the Weighted Average Cost of Capital (WACC) for capital budgeting.

Black, Jensen, and Scholes (1972) reported the first notable test of the CAPM. Their methodology is mainly a time series regression framework. The CAPM states that the expected return of any capital asset is proportional to its systematic risk measured by the beta. Fama and Macbeth (1973) further tested the cross section relationship implied by the CAPM. They found the risk premium for beta is positive and the average return on the asset uncorrelated with the market is equal to the risk free rate of interest. In the first step of their two pass procedure the risk variables are estimated via a time series regression of the excess asset return on the excess markets return. The subsequent monthly returns on the asset are then cross-sectionally regressed on the risk variables estimated from previous data which provide the estimates of the risk premium. The empirical evidence suggests that the relationship between average asset returns and the beta was positive, but not too strong. To test the model implication that beta is the only relevant risk variable, they also included the squared beta and the residual variance as explanatory variables. These variables did not significantly improve the explanatory power.

In studies of the US stock market, Friend, Granito, and Westerfield (1978), Lakonishok and Shapiro (1986) and Fuller and Wong (1988) found there was a significant relationship between non systematic risk and stock returns. The findings of Corhay, Hawamini, and Michal (1988) in relation to the British stock market were similar. There was a positive relationship between returns and nonsystematic risk. In Asian markets Wong and Tan (1991) tested the validity of the CAPM in the Singapore Stock Exchange. Their results indicate that the relationship between systematic risk and

average return appeared to be linear in beta. However, the sign of the beta risk premium was opposite to that predicted by the CAPM and only a few beta coefficients were significant. Skewness appeared to be significant in two of the five years with individual stocks but with portfolio data the significant effect of skewness disappeared. Bark (1991) used the Fama and MacBeth methodology to test whether the CAPM is applicable to the Korean stock market. A positive trade-off between market risk and return is rejected and other factors such as unique risk were shown to play an important role in pricing risky assets. Cheung and Wong (1992) studied the relationships between stock returns and various measures of risk in the Hong Kong Equity Market over the period 1980-89. On the whole, the application of the CAPM in Hong Kong appeared weak. The market risk was only priced for the year 1984-85. Cheung, Wong, and Ho (1993) performed empirical tests on the relationships between average stock returns and some measures of risk, including skewness, on two of the most important emerging Asian stock markets, Korea and Taiwan. The applicability of the CAPM seemed weak in both markets, particularly in Taiwan. Huang (1997) also reported an inverse relationship between returns and systematic risk, unique risk, and total risk respectively, in the Taiwan stock market.

Research into beta is broad and has highlighted a number of limitations particularly in regards to the stability of the beta coefficient over time which has been found in both developed and developing markets (Harvey, 1989; Ferson & Harvey, 1991; Fama & French, 1992; Ferson & Korajczy, 1995; Huang, 2001; Oran & Soytas, 2009; Mollik & Bepari, 2010). Beta instability can be reduced however as both portfolio size and sample duration increases (Fama & Macbeth, 1973; Odabasi, 2000). A paper by Kapusuzoglu (2008) examined the alpha and beta values in the Istanbul Stock Market and highlighted the variability of the beta parameter. It encourages investors to utilize the CAPM as a supplementary instrument in the process of portfolio information and to avoid relying on it as a sole indicator guiding investment strategy. In recent years, the CAPM has been attacked as an incomplete model for explaining market pricing behavior, but academics and practitioners cannot agree on a good replacement. Hence, the CAPM remains an important model in practical investment and financial management decision making.

4. Data and Methodology

Daily returns from the TASI and each of its 15 sectors from April 2007 until December 2011 are collected. All data are extracted from the Thompson-Reuters Datastream database. The data for non-trading days as a result of weekends and national holidays are adjusted by setting the daily return to zero. A total of 1208 usable observations are collated and daily percentage changes of each data series calculated. Three TASI market extremities are identified which categorize four distinct global shocks which are displayed in Figure 2.

Figure 2: Tadawul All Share Index 2007 – 2011

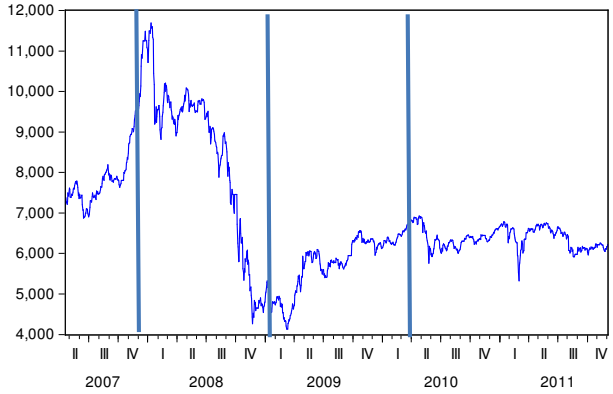


Table 1 identifies the dates and number of data observations for each phase. These phases include: the dramatic increase in world oil prices throughout 2007 and early 2008, the subsequent global financial and economic collapse in late 2008 early 2009, the gradual recovery of global markets in 2010 associated with wide-spread Central Bank quantitative easing activities (the US Federal Reserve pumped more than $2 trillion of new money into the US economy much of which found its way to overseas markets offering higher returns) and finally 2011 – a period dominated by unrest in the Middle East (The Arab Spring), the debt limit fiasco in the United States and the uncertainty over the existence of both the Euro and the EU zone.

Table 1: The Four Global Macroeconomic Shocks

Phase	Date	Observation
The Oil Boom:	19/4/2007 – 29/04/2008	268 data observations
The Crash:	30/4/2008 – 9/3/2009	223 data observations
The Recovery:	10/3/2009 – 14/1/2011	483 data observations
Global Uncertainty:	15/1/2011 – 5/12/2011	230 data observations

Descriptive statistics of daily returns by sector between 2007 and 2011 are calculated. Table 2 shows seven of the 15 sectors have positive average daily returns and eight have negative average daily returns. The average daily market return was zero highlighting the relative weak performance of the broader TASI since 2007. The Petrochemical sector has the highest average daily return (0.04%) and the Investment sector the lowest (-0.05%). The standard deviations are high reflecting wide fluctuations driven by the global shocks listed in Table 2. Nine sectors are negatively skewed and six sectors are positively skewed with the overall market slightly negative skewed. Movements at the right tail of the return distribution reflect higher percentage returns and can be construed as beneficial to market investors.

Table 2: Descriptive Statistics of Daily Returns by Sector 2007 – 2011

Sector	Mean	Std. Dev.	Skewness	Kurtosis
TASI Index	0.00	1.66	-0.44	11.63
Agriculture	0.02	1.73	-0.38	10.70
Banking	-0.01	1.69	0.06	10.64
Building	-0.02	2.09	-0.46	9.98
Cement	0.01	1.47	-0.21	15.03
Energy	0.01	1.66	0.24	10.79
Hotel	0.03	2.47	1.40	21.90
Industrial	0.03	2.02	-0.14	13.87
Insurance	-0.01	2.24	-0.66	6.91
Investment	-0.05	2.15	0.08	14.35
Media	-0.04	2.02	0.18	10.00
Petroleum	0.04	2.53	1.22	37.41
Real Estate	-0.04	1.75	-0.08	13.84
Retail	0.04	1.68	-0.15	13.31
Telecom	-0.02	1.67	-0.22	11.50
Transport	-0.02	2.06	-0.05	9.36

5. Analysis and Results

Daily data for each sector are regressed against the TASI returns for all observations. A series of beta coefficients are calculated. They identify the sensitivity of the sector returns to the market returns for each cycle and the complete sample period. Each beta coefficient measures part of the asset's risk (systematic) that cannot be removed through diversification. Table 3 presents the beta for all fifteen sectors of the TASI across each four distinct market phase as well as the overall period.

Table 3: Beta coefficients for all sectors over each cycle

	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycles 1-4	
Sector	**Oil Boom**	**Global Crash**	**Recovery**	**Global Uncertainty**	**Overall**	**CV - Beta Volatility****
Petroleum*	1.16	1.27	1.84	1.21	1.37	23.11%
Building*	0.92	1.18	0.97	1.15	1.09	12.25%
Industrial*	0.94	1.03	1.18	1.04	1.04	9.46%
Multi Investment*	1.04	1.01	0.98	1.28	1.04	12.73%
Transport*	1.01	1.06	0.72	1	0.96	16.24%
Insurance*	0.68	1.02	0.84	1.22	0.94	24.75%
Hotel and Tourism	0.93	0.93	0.98	0.85	0.93	5.82%
Banking*	1.02	0.92	0.81	0.92	0.91	9.35%
Real Estate*	1.01	0.93	0.73	0.79	0.88	14.79%
Agriculture*	0.86	0.95	0.66	1.02	0.87	17.89%
Media/Publishing	0.78	0.85	0.87	0.86	0.84	4.86%
Telecommunications	0.8	0.9	0.7	0.88	0.83	11.09%
Cement	0.66	0.77	0.4	0.65	0.65	25.23%
Retail	0.73	0.87	0.68	0.92	0.63	14.18%
Energy Utilities	0.86	0.51	0.49	0.67	0.59	27.15%

*Sectors with beta fluctuating above/below 1

**Beta Volatility calculated using the coefficient of variation.

Table 3 shows the Petroleum sector has the highest beta coefficient across the total sample. The overall value of 1.37 suggests that for every one per cent increase in overall market returns, the returns for the Petroleum sector will increase by 1.37 per cent. Sector betas with a value exceeding one are usually associated with growth and higher risk sectors and are attractive to risk-seeking investors searching for higher returns. High beta indices are therefore attractive during periods of bull markets. Conversely, the Energy Utilities sector has the lowest overall beta of 0.59 per cent – for every one per cent increase in the broader market, the Energy Utilities sector rises by 0.59 per cent. Therefore the Energy Utilities sector is less sensitive to broader market movements compared to the Petroleum Sector. Typically stocks/indices with betas below one are classified as defensive or lower risk investments and are more attractive to risk-averse investors and tend to outperform in bear markets.

Table 3 further reveals that the beta coefficient within each sector fluctuates over time. The variation in the cyclical betas compared to the beta coefficient over the four years empirically captures the short term exposure to market-moving events (systematic risks) such as the four global shocks identified earlier in Table 2. The efficacy of applying a single beta coefficient over a long period of time (albeit four years) to signal future forecasts of asset performance and required returns challenges its reliability as a market signal. As can be seen, eight of the 15 sectors in the TASI market have beta values which fluctuate between a value greater than one and less than one over the sample period. Clearly investors formulating an investment strategy based on beta values could be misled by relying on a single static beta value, particularly for a period encompassing such major systematic market-moving events.

The final column in Table 3 uses the coefficient of variation (CV) to measure the stability of the beta across the four different phases. A higher CV implies higher volatility. Results show high relative volatility across the sectors over time. To improve the reliability of the beta coefficient signal and overcome the limitations of a single beta coefficient derived from a period of past returns, the authors suggest calculating a 'rolling' beta. Since economies are dynamic and the gathering of information is perpetual, a rolling regression technique is applied to generate daily beta values for each sector. A rolling regression of 100 daily returns is conducted and rolled on a daily basis throughout the entire sample period. By applying a rolling regression technique 1108 daily beta estimates are generated instead of one single beta estimate which best fits the sample data. Descriptive statistics of the beta values across all fifteen sectors are presented in Table 4 and are presented in sequence of beta volatility as measured by the coefficient of variation.

Table 4: Descriptive Statistics of Rolling daily betas 2007 – 2011, by sector.

Sector	Mean	Std. Dev.	Kurtosis	Skewness	C.V
Hotel	0.855	0.324	4.926	1.856	37.93
Energy	0.607	0.188	-0.036	0.642	30.95
Cement	0.601	0.158	1.912	-1.252	26.23
Investment	1.014	0.260	-0.144	0.570	25.6
Transport	0.866	0.213	-0.627	-0.560	24.66
Retail	0.727	0.178	-0.542	0.121	24.43
Petrochemical	1.365	0.323	2.047	1.588	23.66
Media/ Publishing	0.805	0.187	0.313	0.243	23.26
Insurance	0.944	0.214	-0.873	-0.279	22.68
Real Estate	0.795	0.179	-0.742	-0.108	22.56
Agriculture	0.828	0.159	-0.678	0.410	19.22
Banking	0.953	0.168	0.657	-0.022	17.67
Industrial	1.030	0.171	0.338	0.280	16.61
Building	1.009	0.164	-0.942	-0.060	16.28
Telecommunications	0.784	0.119	0.129	-0.284	15.19

The rolling beta coefficient identifies the daily risk-return relationship between the sector and the market, based on historical daily return data. The CV provides the relative volatility of the rolling beta. A high CV suggests high variability of the beta coefficient. Hence without reference to the CV, the beta alone disguises the true signal of the sector-market relationship. Interestingly, the Energy and Cement sectors have the lowest two beta values 0.607 and 0.601, and the second and third highest relative beta volatility, (measured by CV) 30.95 and 26.23. These imply that both sectors are less sensitive to market movements (because of low betas), which further implies lower risk which in turn would be attractive to risk-averse investors. However, the high rolling beta volatility (as measured by CV) implies high risk, which contradicts the readings of the low static beta value. It is therefore helpful to calculate the rolling beta, as well as calculating the CV, to allow a more informed investment decision. Figures 3 to 4 illustrate how the beta value for each sector changes as it is rolled through the sample period. They highlight how beta substantially deviates from the overall static beta calculation presented earlier in Table 3.

Figure 3: Hotel Sector Rolling and Static Beta

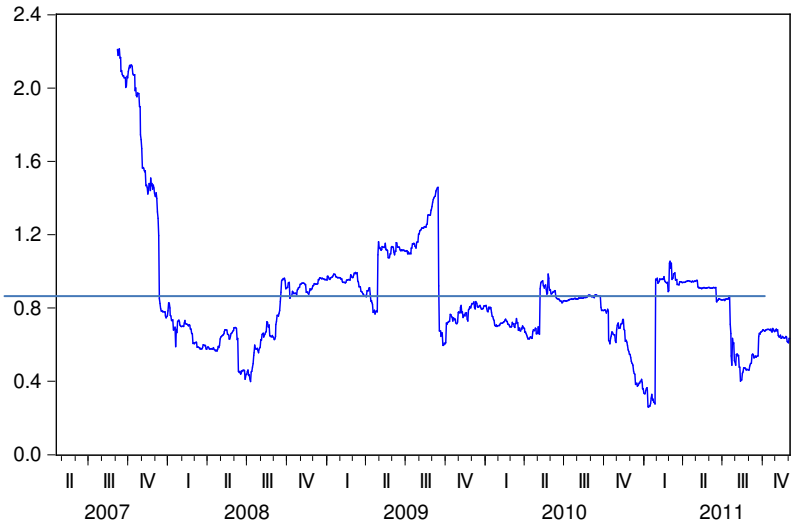
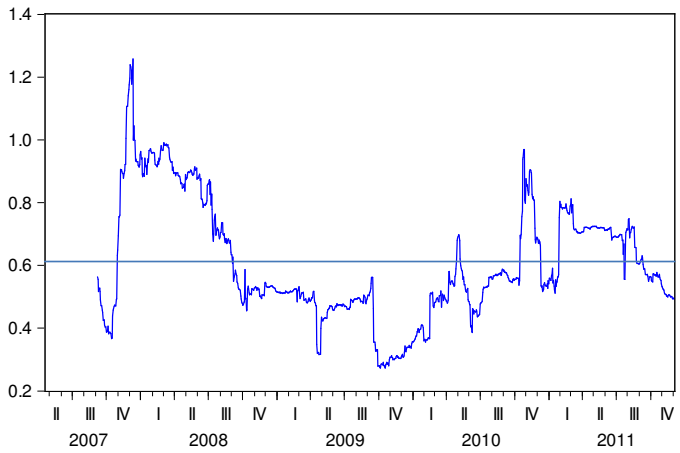


Figure 4: Energy Sector Rolling and Static Beta



Within all 15 sectors, there are wide fluctuations of the rolling beta coefficients above and below the market beta of one. Figures 3 and 4 illustrate the two most volatile sectors. The static betas of 0.85 and 0.60 for the hotel and cement sectors respectively paint a very different picture of market risk compared to the rolling beta. (Further data on other sectors are available from the authors). This underlines the limitation of using a static beta value over a period of time to guide risk management. A rolling beta better reflects any changes in current market conditions and provides a more accurate and reliable beta coefficient estimate. Risk-seeking investors choosing stocks/indices based on beta values above one, do so without knowing the relative volatility of the static beta value. Paradoxically, a static beta greater than one, may simultaneously have a rolling beta less than one. Hence the signal being sent to investors from the static beta value may be completely misleading.

The final part of this paper determines whether sector returns are over-valued or under-valued using the CAPM. Members of the financial community that don't believe in the Efficient Market Hypothesis attempt to construct investment strategies that generate a positive alpha. Alpha measures the securities actual return minus the expected return as predicted by the CAPM. Positive alphas indicate a security which has outperformed its expected return. Simultaneously it provides an indication of securities/indices that are undervalued by the market. Using the rolling betas generated previously, daily alphas are constructed for each of the 15 sector indices in the TASI.

Utilizing average rolling beta values across each of the four macroeconomic cycles, expected returns for each of the sectors are calculated using the CAPM model equation:

Sectors Required Return = Risk Free Rate + Beta (Market Return – Sector Return)

Sectors required return compensates investors for both placing money in any investment over a period of time, as well as for sector risk. Since the US/KSA fixed exchange rate agreement demands an alignment of US - KSA monetary policy, the risk-free rate is measured by the yield on the US 90 day T-bill. The market return is the TASI Index return. The calculated sectors required returns can then be compared with the sectors' actual returns to derive the sectors' alpha coefficient. A positive alpha indicates a sector that has outperformed (a sector that is undervalued by the market) according to the CAPM. This in turn signals an opportunity for investors to buy. Conversely a negative alpha indicates a sector that has underperformed (a sector that is overvalued by the market). Table 5 presents each sector's valuation across each of the four macroeconomic cycles.

Table 5: Valuations by Sector

Period					
Sector	**1**	**2**	**3**	**4**	**Overall**
Banking	**BUY**	overvalued	overvalued	overvalued	overvalued
Petroleum	**BUY**	overvalued	**BUY**	overvalued	overvalued

Table 5: Valuations by Sector - continued

Telecom	overvalued	overvalued	overvalued	overvalued	overvalued
Cement	overvalued	overvalued	overvalued	**BUY**	overvalued
Agriculture	overvalued	overvalued	overvalued	overvalued	overvalued
Real Estate	**BUY**	overvalued	overvalued	overvalued	overvalued
Industrial	overvalued	overvalued	**BUY**	overvalued	overvalued
Retail	overvalued	overvalued	overvalued	**BUY**	overvalued
Building	overvalued	overvalued	overvalued	overvalued	overvalued
Energy Utilities	overvalued	overvalued	overvalued	overvalued	overvalued
Insurance	overvalued	overvalued	overvalued	**BUY**	overvalued
Multi Investment	**BUY**	overvalued	overvalued	**BUY**	overvalued
Transport	**BUY**	overvalued	overvalued	overvalued	overvalued
Media	overvalued	overvalued	overvalued	**BUY**	overvalued
Hotel	overvalued	overvalued	overvalued	**BUY**	overvalued

Table 5 presents an interesting story. When relying on a static beta value to calculate required returns, every sector in the TASI throughout the four year period is overvalued. But closer scrutiny, using the rolling beta regression technique, enables the CAPM to more accurately capture valuation swings caused by market-moving events over time.

Prior to the global financial crisis, five of the fifteen sectors in the TASI were undervalued in a period of soaring oil prices. These sectors generated returns that exceeded the required returns determined by the CAPM calculations. With the onset of the global financial crisis (Cycle 2), all sectors in the TASI returned negative alphas implying the market has incorrectly overvalued these sectors. As the global economy recovered in Cycle 3, the Petroleum and the Industrial sectors generated positive alpha values in a period of massive quantitative easing, much of which found its way into commodities fuelling the resurgence in world oil prices. Despite global uncertainty in 2011 (Cycle 4) results show an increasing number of sectors becoming undervalued. This suggests investment opportunities are re-emerging in the TASI - a very different story to the one being told when applying the static beta value.

6. Discussion and Concluding Observations

This paper analyses the sensitivity of sector risk-return relationships in the TASI over the period 2007-2011. Evidence shows that beta is time-variant. Analysis also found using the traditional static beta value alone without consideration to its relative daily instability may distort sector-market relationship signals and lead to spurious information. The policy implication suggests that investors should not rely on the static beta value as a sole guiding investment tool. The contribution of this paper provides a more refined technique, a rolling beta, to accurately capture daily valuation swings caused by market-moving events over time. Alpha values were calculated using the CAPM enabling more dynamic risk-return valuations to emerge. These valuations identified four key phases of varying stock market activity and sector market valuations previously unrecognized when using the static beta value.

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