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Systematic Risk at the Industry Level: A Case Study of Australia

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Abstract: The cornerstone of the capital asset pricing model (CAPM) lies with its beta. The question of whether or not beta is dead has attracted great attention from academics and practitioners in the last 50 years or so, and the debate is still ongoing. Many empirical studies have been conducted to test the validity of beta within the framework of CAPM. However, it is a claim of this paper that beta at the industry level has been largely ignored in the current literature. This study is conducted to examine if beta, proxied for a systematic risk, should be considered valid in the application of the CAPM at the industry level for Australia using daily data on 2200 stocks listed on the Australian Securities Exchange from January 2007 to 31 December 2016. Various portfolio formations are utilized in this paper. General economic conditions such as interest rate, inflation, and GDP are examples of systematic risk. Findings from this study indicate that the selection of portfolio construction, estimation technique, and news about economic conditions significantly affects the view whether or not beta should be considered as a valid measure of systematic risk.

Keywords: systematic risk; beta; CAPM; industry; Australia

1. Introduction

The capital asset pricing model (CAPM) has gained acceptance for use by academics and practitioners for an extended period of time. The central piece of the CAPM is its beta. A recent work by Savor and Wilson (2014) presented that beta is an important measure of systematic risk. They found that beta is strongly, as well as positively, related to average excess return on days when inflation, employment, or Federal Open Market Committee interest rate decisions, which are generally considered sources of systematic risk, are announced.

We extend the Savor and Wilson (2014) study by considering the validity of beta in the framework of the CAPM at the industry level in Australia. We argue that various industries within the same economy exhibit different level of responsiveness of news into stock prices.

We have noted that another asset pricing model, the Fama–French three factor model, is highly regarded and frequently used in the US. A debate on the death of beta in the CAPM framework has taken place in recent years, in particular in the US context. However, a recent Savor and Wilson (2014) study confirms that CAPM, and its beta, is still alive, at least in the US market. We are also aware that various Australian utilities regulators, including the Australian Energy Regulator and the Economic

Regulation Authority of Western Australia, have been using the CAPM to estimate the return on equity in their regulatory decisions. Recently, the Fama–French three factor model has been shown to not work well in the Australian context (Vo 2015). From a status quo, our preferred approach is that CAPM and Fama–French three factor model are treated equally. The Fama–French three-factor model has been proven to work well in the US market. Equally, beta is still alive in the US market. The question is whether or not beta represents systematic risk at the industry level in Australia. We are not aware of any study on the issue which has been conducted recently. This study is conducted to fill in the gap at the industry level for Australia.

2. Literature Review

Motivated by the seminal work of Markowitz (1952), Sharpe (1964) and Lintner (1965), various empirical studies have been conducted to address the validity of CAPM in practice (Furman and Zitikis 2017a, 2017b; Powell and Vo 2020; Vo and Vo 2019; Tran et al. 2019). Unfortunately, findings from these studies reveal that there is no clear consensus on the relationship between portfolio's betas and their excess return.

Pettengill et al. (1995) collected monthly data from the Federal Reserve Bulletin for the period from January 1926 to December 1990 to address the relationship between betas and realized returns and to address a positive long-run tradeoff between beta risk and return. They detected a consistent and statistical relationship between betas and returns for entire sample as well as sub-samples. From these findings, the authors concluded that a positive nexus on beta-return is found. Using monthly and weekly data from 13 countries from DataStream, Tanga and Shumb (2003) showed that beta and its return were positively related when market return is greater than the risk-free return. Interestingly, their findings also revealed a negative correlation between beta and return when market return is less than the risk-free rate. The findings from these studies suggest that the CAPM is a useful model to estimate the return of a diversified portfolio through its market beta. Berk and Van Binsbergen (2016) collected mutual fund data from Center for Research in Security Prices for the period from January 1977 to March 2011 to examine practical use of CAPM. Their findings indicated that CAPM was an appropriate model to estimate cost of capital. Similarly, in the case of South African, Carter et al. (2017) confirmed the validity of the CAPM using data from 160 shares listed on the Johannesburg Stock Exchange over the period 1984–2014.

The CAPM has been adopted by various economic regulators but it has attracted criticism from many scholars due to its unrealistic assumptions. Using data from 278 listed firms on the Bombay Stock Exchange from the period 1996 to 2009, Choudhary and Choudhary (2010) detected an insignificant relationship between market beta and return and opined that the estimated market risk premium was not equal to the market excess return, as suggested by the CAPM. Based on the empirical findings, they posited that the CAPM should be used with caution. Similarly, using data from the Nigerian stock market from January 2008 to December 2009, Olakojo and Ajide (2010) found a non-linear relationship between market beta and return, instead of the linear relationship suggested by the CAPM. Furthermore, they also showed that their empirical findings were robust to various tests. Al-Qudah and Laham (2013) collected data from 48 stocks listed on the Amman Stock Exchange over the period January 2000 to December 2009 to investigate the relationship between market beta and return. Their empirical findings revealed no statistically significant relationship between these two variables of interests. From another view, various scholars found no market beta–return tradeoff from the Malaysian Stock Exchange from the period 2001 to 2013 (Mollik 2014) or in the Nigerian stock exchange (Oke 2013).

The literature on stock return prediction has attracted great attention from scholars. Together with the CAPM, various models have been proposed to address stock return and market return. They are the Fama–French three factor model (FF3F), the Cahart's four factor model (C4F), and the Fama–French's five factor model (FF5F), among others. It is common knowledge that the FF3F is widely used for stock prediction. The FF3F uses additional risk factors, size factor and value factor, together with the market factor to explain variation in stock return. As such, the FF3F is often compared with the CAPM. Various studies found that the FF3F outperformed the CAPM in terms of stock return prediction, and therefore urged adoption of the FF3F. However, one of the main drawbacks of the FF3F is that the inclusion of the size factor and value factor, which are mostly based on data mining, not a theoretical basis.

In the case of the United Kingdom over the period from April 2000 to June 2007, Bhatnagar and Ramlogan (2012) found that the Fama–French three-factor model can better predict stock return compared to the CAPM. Their empirical findings also suggested that practice use of the CAPM is not appropriate in the United Kingdom. Daniel et al. (2001) compared the stock return prediction of the FF3F and the CAPM in Japan for the period 1971–1997. The main finding of the paper was that the CAPM is not appropriate for Japan and that the FF3F is a much better version. O'Brien et al. (2008) showed that the FF3F was better than the CAPM in stock return prediction using data from the Australian Stock Exchange over the period 1982–2006. The results are consistent to other findings for the Australian Stock Market (Gharghori et al. 2009).

3. Data and Methodology

3.1. Data

A substantially large volume of data is required for this type of analysis. In addition, one of the key cornerstones of this empirical study is the availability of various announcements in relation to macroeconomic issues such as economic growth, money supply, and unemployment. As such, various industries in Australia are selected for the purpose of the analysis.

The study investigates daily data on 2200 stocks listed on the Australian Securities Exchange from January 2007 to 31 December 2016 in addition to data on the risk-free rate of Commonwealth Government bonds issued by Reserve Bank of Australia in the same period.

Australian listed firms are then classified into various industries, including (i) Consumer discretionary, (ii) Consumer Staples, (iii) Energy, (iv) Financials, (v) Health care, (vi) Industrials, (vii) Information technology, (viii) Materials, (ix) Real estate, (x) Telecommunication services, and (xi) Utilities.

It is widely argued that the economic condition of a country is reflected through its interest rate, inflation, or GDP. An annnouncement on interest rate, inflation or GDP is suitable to be a proxy for systematic risk. It is noted that, for an economy, macroeconomic announcements are issued by its central bank and/or national government on some days, whereas there may be no announcements at all on the other days. In this paper, days with macroeconomic announcements are allocated into the **a-day** (announcement day) group, whereas the **n-day** (non-announcement day) group includes days without any macroeconomic announcements. To the best of our knowledge, macroeconomic announcements are available on http://www.forexfactory.com and we consider all of them in this paper. As such, macroeconomic announcements are equivalent to news about growth, inflation, employment, central bank announcements, bonds, housing, consumer surveys, business surveys and speeches from the Prime Minister or the Governor of the Reserve Bank of Australia

3.2. Portfolio Constructions

On the basis of Vo (2015), in relation to various formations of portfolios, the following portfolio formations are utilized in this paper.

- Ten beta-sorted portfolios and ten idiosyncratic risk-sorted portfolios

In relation to the ten-beta sorted portfolios, separately for the a-day and n-day, the beta for each individual stock is estimated using one year of daily stock returns. After that, stocks are allocated into 10 different deciles in accordance with their estimated betas. The first decile includes the 10% lowest estimated beta while the last decile contains the 10% highest estimated beta. All these portfolios are rebalanced annually depending on their estimated betas.

The construction of the ten idiosyncratic risk-sorted portfolios is conducted in the similar manner. However, in this type of portfolio formation, the standard deviation of the residuals obtained from the estimates of the Sharpe–Lintner CAPM is used instead of the estimated beta, as discussed above.

- The 25 Fama-French size and book-to-market portfolios

The paper utilizes the approach adopted in Fama and French (1996) to construct the 25 Fama–French size and book-to-market portfolios.

- The 11 industry portfolios

Based on the Global Industry Classification Standard (GICS), a firm is assigned to the relevant sector by its principal business activity. In this paper, we follow the classification of GICS to construct an industry portfolio. Hence, for the case of Australia, 11 portfolios are formed based on this approach. These industries include Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Rechnology, Materials, Real Estate, Telecommunication services, and Utilities.

3.3. Methodology

The key objective of this paper is to examine the hypothesis that beta is a measure of systematic risk at the industry level in Australia. The following model is utilized for pooled regression

$$R_{i,t+1} - R_{f,t+1} = \propto_0 + \gamma_1 D_{t+1} + \gamma_2 (1 - D_{t+1}) \beta_{i,t}^N + \gamma_3 D_{t+1} \beta_{i,t}^A + \varepsilon_{i,t+1} \quad (1)$$

where i represents each portfolio and t represents each period. $R_{i,t+1}$ represents portfolio return. $R_{f,t+1}$ represents risk-free rate return. $\beta_{i,t}^N$ is estimated portfolio market beta using return on the n-day only. $\beta_{i,t}^A$ is estimated portfolio market beta using return on the a-day only. D is a dummy variable whose value is one if the day is the a-day during period t and zero if otherwise. $\varepsilon_{i,t+1}$ is the error term. Equation (1) is estimated using the linear regression with the panel-corrected standard errors method. This is because the techniques take into account the heteroscedasticity and contemporaneously correlated across panels of disturbances.

In addition, the paper also employs the Fama and MacBeth (1973) regression technique. The Fama and MacBeth regression technique is characterized by two stages of estimation. In the first stage, coefficient β of Equation (2) is estimated through time series regression. In the second stage, a single cross-sectional regression for Equation (3), in which the mean excess return is estimated against the coefficient β, is implemented.

$$R_{i,t} - R_{f,t} = \propto_0 + \beta\left(R_{m,t} - R_{f,t}\right) + \varepsilon_{i,t} \quad (2)$$

$$\bar{R}_{p,t} - \bar{R}_{f,t} = \alpha + \theta_p \beta \quad (3)$$

In this paper, we estimate the following equations using the Fama and MacBeth (1973) regression technique

$$R_{i,t+1}^A - R_{f,t+1}^A = \alpha_1 + \theta_1 \beta_{i,t}^A + \varepsilon_{i,t+1} \quad (4)$$

$$R_{i,t+1}^N - R_{f,t+1}^N = \alpha_0 + \theta_0 \beta_{i,t}^N + \varepsilon_{i,t+1} \quad (5)$$

where $R_{i,t+1}^A$ represents portfolio return on the a-day. $R_{f,t+1}^A$ represents risk-free rate return on the a-day. $R_{i,t+1}^N$ represents portfolio return on the n-day. $R_{f,t+1}^N$ represents portfolio return on the n-day.

4. Results

4.1. Pooled Regression

The empirical results are presented the in the first three columns of Table 1. Beta will be a good measure of systematic risk if the following two conditions are met: (i) the coefficient of γ_3 from Equation (1) is statistically significant; and (ii) the hypothesis of "$\gamma_2 = \gamma_3$" from Equation (1) is rejected.

Table 1. Estimation results of Equations (1), (4) and (5).

Portfolio	Pooled Regression			Fama–MacBeth Regression		
	Equation (1)			Equation (4)	Equation (5)	
	γ_2 (1)	γ_3 (2)	H_0: $\gamma_2 = \gamma_3$ (3)	θ_0 (4)	θ_1 (5)	H_0: $\theta_0 = \theta_1$ (6)
Panel A: Value weighted						
Ten–beta sorted portfolios	−0.0008537 *** (0.000)	−0.0010513 ** (0.015)	(0.713)	−0.0006986 *** (0.004)	−0.0011829 *** (0.002)	(0.337)
Ten idiosyncratic risk-sorted portfolios	−0.0013402 ** (0.050)	−0.0007671 (0.853)	(0.434)	−0.0023241 *** (0.000)	−0.0004931 (0.302)	(0.029)
25 Fama and French size and book-to-market portfolios	−0.0060289 *** (0.001)	−0.0002959 ** (0.025)	(0.009)	−0.0077532 *** (0.000)	−0.0002291 (0.828)	(0.034)
11 industry portfolios	0.0001765 (0.672)	−0.0011396 * (0.053)	(0.030)	−0.0004936 (0.450)	−0.0002579 (0.504)	(0.760)
Panel B: Equal weighted						
Ten–beta sorted portfolios	−0.0000858 (0.604)	−0.0003735 * (0.068)	(0.046)	−0.0002985 * (0.052)	−0.0005253 *** (0.004)	(0.462)
Ten idiosyncratic risk-sorted portfolios	0.0017271 *** (0.000)	−0.0004429 (0.694)	(0.071)	0.0016528 *** (0.000)	−0.0007247 (0.300)	(0.005)
25 Fama and French size and book-to-market portfolios	0.0027336 *** (0.000)	0.0012829 (0.144)	(0.124)	0.0013597 ** (0.015)	0.0002142 (0.817)	(0.326)
11 industry portfolios	−0.0002233 (0.737)	−0.0017267 * (0.083)	(0.104)	−0.0007023 (0.304)	−0.0014392 (0.218)	(0.608)

Note: The *p*-values are reported in parentheses. * significant at 10% level, ** significant at 5% level, *** significant at 1% level. In Panel A, return for a portfolio is the weighted average of the return of each of its components. The weight of each stock is the percentage of the total portfolio market value in which the stock presents. In Panel B, return for a portfolio is calculated as the ration between the individual stock returns and the number of stocks.

In relation to Panel A, the results are not consistent across four different types of portfolio formations. In particular, the coefficient of γ_3 is statistically significant for three out of four portfolio formations, including (i) the ten beta-sorted portfolios; (ii) the 25 Fama–French size and book-to-market portfolios; and (iii) the 11 industry portfolios. The condition is not satisfied for the ten idiosyncratic risk-sorted portfolios.

In addition, in relation to the second criteria, which is that the hypothesis of "$\gamma_2 = \gamma_3$" from Equation (1) is rejected, only the ten beta-sorted portfolios formation does not satisfy this condition. However, the remaining two portfolio formations satisfy the condition that the hypothesis of "$\gamma_2 = \gamma_3$" is rejected including the 25 Fama–French size and book-to-market portfolios, and 11 industry portfolios. In short, for most of different portfolio formations, the empirical findings from this study indicate that beta is a relatively good measure of systematic risk at the industry level in Australia.

In Panel B, given the expected conditions above, the performance of the ten beta-sorted portfolios further confirms the validity of the Sharpe–Lintner CAPM model. Particularly, the coefficient of γ_3 is statistically significant at the level of 1% and the hypothesis of "$\gamma_2 = \gamma_3$" is rejected at the level of 10%.

In summary, our empirical findings show that beta represents systematic risk at the industry level in Australia with ten-beta sorted portfolios, 25 Fama and French size and book-to-market portfolios and 11 industry portfolios using pooled regression techniques.

4.2. Fama–MacBeth Regression

The results are obtained in the last three columns of Table 1. Beta will be a measure of systematic risk if two conditions are met. They are (i) the coefficient θ_1 is statistically significant; and (ii) the hypothesis of "$\theta_0 = \theta_1$" is rejected.

Interestingly, for most considered portfolios, the empirical findings suggest that the estimates of θ_1 from the Fama–MacBeth regression are not statistically significant, except for the ten-beta sorted portfolios, which is in contrast to our expectation. In relation to Column 6, in which the hypothesis of "$\theta_0 = \theta_1$" is tested, the empirical results do not seem follow our expectation, as the hypothesis is not rejected.

In summary, we find that no portfolios from our analyses support a view that beta represents systematic risk at the industry level in Australia using the Fama–Macbeth regression technique. This empirical result, together with findings shown in Section 4.1, reveals that estimation techniques significantly contribute to the verification of whether or not beta should be considered as a measure of systematic risk.

5. Robustness Check

5.1. Beta on a-Day vs. Beta on n-Day

We have estimated portfolio beta separately on a-day and on n-day. Nevertheless, this approach will lead to biased results if market betas on a-day are not different from their counterparts on n-day. Savor and Wilson (2014) demonstrated that no differences were found among a-day beta and n-day beta, and thus suggested that using the same beta did not affect results. Their findings, in its turn, induce us to raise a hypothesis of whether or not a-day beta are different from n-day beta given the dataset. Table 2 presents a test of difference between a-day beta and n-day beta. It is noted that few differences were found.

Table 2. A comparison of beta on a-day and beta on n-day for industry portfolio.

	Value–Weighted Return			*Equal-Weighted Return*		
	β_{non}	$\beta_{ann} - \beta_{non}$	*p*-Value	β_{non}	$\beta_{ann} - \beta_{non}$	*p*-Value
Consumer Discretionary	0.76	−0.045	(0.301)	0.65	0.024	(0.469)
Consumer Staples	0.68	−0.011	(0.765)	0.70	−0.121	(0.304)
Energy	1.09	−0.029	(0.369)	1.21	0.006	(0.809)
Financials	1.01	0.013	(0.615)	0.68	0.024	(0.581)
Health Care	0.63	−0.012	(0.832)	0.727	0.047	(0.520)
Industrials	0.95	−0.044	(0.156)	0.87	−0.068	(0.172)
Information Technology	0.71	−0.003	(0.926)	0.88	−0.032	(0.702)
Materials	1.39	−0.017	(0.470)	1.28	0.016	(0.585)
Real Estate	0.72	0.085	(0.156)	0.59	−0.028	(0.260)
Telecommunication Services	0.50	0.029	(0.683)	0.68	0.142	(0.084) *
Utilities	0.59	−0.014	(0.726)	0.85	−0.130	(0.307)

Note: The p-values are reported in parentheses. * significant at 10% level. To each test, the null hypothesis is "β_{ann} equals β_{non}" and the alternative hypothesis is "β_{ann} is different from β_{non}".

Given the fact that a-day beta and n-day beta are similar, we repeat the portfolio construction described in Section 3.2 with no consideration of the type of day and estimate the impact of portfolios' beta on their subsequent excess returns, which are specified by the following equations

$$R_{i,t+1} - R_{f,t+1} = \propto_0 + \gamma_1 D_{t+1} + \gamma_2 \beta_{i,t} + \gamma_3 D_{t+1} \beta_{i,t} + \varepsilon_{i,t+1} \quad (6)$$

$$R^A_{i,t+1} - R^A_{f,t+1} = \alpha^A_0 + \gamma^A_0 \beta_{i,t} + \varepsilon_{i,t+1} \quad (7)$$

$$R^N_{i,t+1} - R^N_{f,t+1} = \alpha^N_0 + \gamma^N_0 \beta_{i,t} + \varepsilon_{i,t+1} \quad (8)$$

where $\beta_{i,t}$ represents portfolio market beta, which is estimated using one year of daily returns on both a-day and n-day.

Equation (6) is estimated with the pooled regression while Equation (7) and Equation (8) are estimated with the Fama and Macbeth (1973) regression.

The aim of the research is to verify beta as a measure of systematic risk. To this end, the following criteria are applied. To Equation (6), these can have a significance of γ_3. To Equations (7) and (8), these can have a significance of γ^A_0 and a hypothesis of "$\gamma^A_0 = \gamma^N_0$" is rejected. Results are reported in Table 3 and Table 4, respectively.

In relation to Table 3, empirical findings suggest that ten-idiosyncratic, risk-sorted portfolios under the value-weighted approach, and ten-beta sorted portfolios under the equal-weighted approach, confirm the view that beta should be considered as a measure of systematic risk. This is because the coefficient γ_3 is statistically significant at the level of 1%.

In relation to Table 4, our results reveal that the coefficient γ^A_0 is statistically significant and the hypothesis of "$\gamma^A_0 = \gamma^N_0$" is rejected for 11 industry portfolios under the value-weighted and equal-weighted approach, and ten-beta sorted portfolios under the equal-weighted approach. That suggests that beta can be considered as a measure of systematic risk

In summary, we find the evidence of beta as a measure of systematic risk using pooled regression and Fama and Macbeth regression. This result is not consistent with our previous findings, presented in Section 4. We conjecture that the difference can be attributed to portfolio market beta estimation. It is noted that in Section 4, portfolio market beta is estimated using return on the a-day only or return on the n-day only, while, in this Section, portfolio market beta is estimated using return on both a-day and n-day.

Table 3. Estimation results of Equation (6).

Portfolio	Value Weighted				Equal Weighted			
	α_0	γ_2	γ_3	*R-Squared*	α_0	γ_2	γ_3	*R-Squared*
Ten–beta sorted portfolios	0.0011544 *** (0.000)	−0.009351 *** (0.000)	−0.007943 (0.179)	0.2115	0.0002132 (0.678)	−0.0000844 (0.652)	−0.000427 *** (0.027)	0.0679
Ten idiosyncratic risk–sorted portfolios	0.0024847 *** (0.007)	−0.0008042 (0.136)	−0.00026574 *** (0.003)	0.1775	−0.0017595 *** (0.002)	0.0018386 *** (0.000)	−0.0011825 (0.316)	0.0796
25 Fama and French size and book-to-market portfolios	0.0089463 *** (0.000)	−0.0066697 *** (0.000)	−0.0004057 (0.832)	0.1590	−0.0024407 *** (0.000)	0.0027477 *** (0.000)	0.0011519 (0.435)	0.1627
11 industry portfolios	0.000417 (0.897)	0.000136 (0.744)	−0.0010626 (0.117)	0.0337	0.0002626 (0.715)	−0.0002931 (0.672)	−0.0009932 (0.316)	0.0361

Note: The *p*-values are reported in parentheses. *** significant at 1% level.

Table 4. Estimation results of Equations (7) and (8).

Portfolio	Equation (7)			Equation (8)				
	α_0^N (1)	γ_0^N (2)	*Avg. R-squared* (3)	α_0^A (4)	γ_0^A (5)	*Avg. R-squared* (6)	$\alpha_0^A - \alpha_0^N$	$\gamma_0^A - \gamma_0^N$
Panel A: Value weighted								
Ten–beta sorted portfolios	0.0010023 *** (0.000)	−0.0007923 *** (0.002)	0.3415	0.0009428 *** (0.004)	−0.0016105 *** (0.000)	0.3180	−0.0000595 (0.879)	−0.0008182 (0.126)
Ten idiosyncratic risk-sorted portfolios	0.0025646 *** (0.000)	−0.0009736 ** (0.012)	0.1789	0.0016247 * (0.088)	−0.0014066 * (0.083)	0.1870	−0.0009399 (0.367)	−0.000433 (0.610)
25 Fama and French size and book-to-market portfolios	0.0103764 *** (0.000)	−0.0083666 *** (0.000)	0.0729	0.0045476 *** (0.001)	−0.0038422 *** (0.008)	0.0721	−0.0058288 ** (0.053)	0.0045244 (0.162)
11 industry portfolios	0.0001978 (0.554)	−0.0000439 (0.920)	0.2067	0.0011557 * (0.088)	−0.0018535 ** (0.042)	0.2216	0.0009579 (0.189)	−0.0018096 * (0.060)
Panel B: Equal weighted								
Ten-beta sorted portfolios	0.0003986 * (0.063)	−0.0002983 * (0.068)	0.2346	−0.0003981 (0.336)	−0.0009531 *** (0.001)	0.2174	−0.0007967 * (0.0849)	−0.0006548 * (0.059)
Ten idiosyncratic risk-sorted portfolios	−0.0017928 *** (0.000)	0.0018461 *** (0.000)	0.2142	−00005981 (0.348)	−0.0007552 (0.341)	0.2045	0.0011946 (0.119)	−0.0026013 *** (0.002)
25 Fama and French size and book-to-market portfolios	−0.0014938 *** (0.005)	0.0018162 *** (0.001)	0.0723	−0.0018314 * (0.073)	0.000413 (0.707)	0.0780	−0.0003375 (0.768)	−0.0014031 (0.240)
11 industry portfolios	−0.0000998 (0.772)	0.0000665 (0.870)	0.1214	0.0003873 (0.538)	−0.0017296 ** (0.014)	0.1093	0.0004871 (0.507)	−0.0017951 ** (0.034)

Note: The *p*-values are reported in parentheses. * significant at 10% level, ** significant at 5% level, *** significant at 1% level. In Panel A, return for a portfolio is the weighted average of the return of each of its components. The weight of each stock is the percentage of the total portfolio market value in which the stock presents. In Panel B, return for a portfolio is calculated by dividing the sum of its individual stock returns by the number of stocks.

5.2. Other News about Economic Conditions

The choice of news about Central Bank and bonds (financial event-related news) as an example of systematic risk seems to be arbitrary and, hence, potentially ignores other news about economic condition. As such, in order to tap other news, which affects a large number of assets, we further consider news about growth, inflation, employment, Central Bank, bonds and speeches from the Prime Minister or the Governor of the Reserve Bank of Australia, which is temporarily called macroeconomic event-related news, news about housing, consumer survey and business survey, which is temporarily called microeconomic event-related news, news about growth, inflation, employment, housing, consumer surveys, business surveys and speeches from the Prime Minister or the Governor of the Reserve Bank of Australia, which is temporarily called economic event-related news.

In relation to each type of news, we repeat the investigation discussed in the Sections 4.1, 4.2 and 5.1, above. Conclusive results are reported in Table 5. Detailed results are provided on request.

Table 5. Conclusive results of other news about economic condition.

Portfolio	Macroeconomic Event-Related News				Microeconomic Event-Related News				Economic Event-Related News			
	Pooled Regression		Fama-Macbeth Regression		Pooled Regression		Fama-Macbeth Regression		Pooled Regression		Fama-Macbeth Regression	
	Common Beta (1)	Conditional Beta (2)	Common Beta (3)	Conditional Beta (4)	Common Beta (5)	Conditional Beta (6)	Common Beta (7)	Conditional Beta (8)	Common Beta (9)	Conditional Beta (10)	Common Beta (11)	Conditional Beta (12)
Panel I: Value weighted												
A												
B												
C												
D												
Panel II: Equal weighted												
A												
B												
C												
D												

Note: Each of the above shaded cells confirm that beta is a measurement of a systematic risk in Australia. Full details of the analyses are provided upon request. Each cell in the first and the fifth column is shaded if the estimates of γ_3 in Equation (1) are significant. Each cell in the second and the sixth column, is shaded if, in Equation (7), the estimate of γ_3 is statistically significant and the hypothesis of $\gamma_2 = \gamma_3$ is rejected. Each cell in the third and the seventh column is shaded if, in Equations (4) and (5), the estimate of γ_0^A is statistically significant and the hypothesis of $\gamma_0^A = \gamma_0^N$ is rejected. Each cell in the fourth and the eighth column is shaded if, in Equations (5) and (8), the estimate of θ_1 is statistically significant and the hypothesis of $\theta_1 = \theta_0$ is rejected.

6. Conclusions

The verification of beta as a measure of systematic risk varies considerably with the type of portfolio construction, the employed estimation technique, and/or the selection of news about economic condition, which partly contribute to the asset pricing puzzle. In addition, our findings are in line with previous studies (Brailsford et al. 2012; Vo 2015).

We observe that portfolio construction does matter. For example, as discussed in Section 4.1, the 25 Fama and French size and book-to-market portfolios and the 11 industry portfolios support the role of beta as a measure of systematic risk, but the ten beta-sorted portfolios and the ten idiosyncratic risk-sorted portfolios do not. From another view, by comparing the conclusive results of Sections 4.1 and 4.2, it is suggestive to state that different estimation techniques yield different conclusions.

From a broader view, we also find the importance of the selection of news about economic condition. In the financial event-related news, there are eight options in which the role of beta is a measure of systematic risk is confirmed, whereas there are three options, two options, and two options for macroeconomic event-related news, microeconomic event-related news, and economic event-related news, respectively.

The Sharp–Lintner version of CAPM has been adopted by economic regulators, policymakers, and financial practitioners around the world for more than 50 years. However, various studies demonstrated that CAPM must be used with caveats.

Recently, a work done by Savor and Wilson (2014) using US data confirmed that beta, the heart of the CAPM, is, after all, an important measure of systematic risk. Put differently, beta is still alive in the US market. On the ground of Savor and Wilson (2014)'s framework, Nguyen et al. (forthcoming) conducted an empirical analysis for Australia. The findings from this most recent study indicated that whether or not beta is a good measure of systematic risk depends on the econometric techniques and portfolio formation of listed firms. This study claims that no effort has been made to consider the validity of the Sharpe–Lintner CAPM in the context of Australia at the industry level, because different industries will respond differently to the same news. We believe this study is the first attempt for the Asia Pacific region.

Using the sample of 2200 Australian listed firms with daily data for the period from 1 January 2007 to 31 December 2016, empirical findings from this study have demonstrated that beta may be alive in the Australian context in portfolio construction and/or econometric techniques. As such, the findings from this study are somewhat similar with those from Vo (2015) and Brailsford et al. (2012), that portfolio constructions do matter when empirical studies on asset pricing are conducted.

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References

AL-Qudah, Anas, and Mahmoud Laham. 2013. The Effect of Financial Leverage & Systematic Risk on Stock Returns in the Amman Stock Exchange (Analytical Study–Industrial Sector). *Research Journal of Finance and Accounting* 4: 136-145

Berk, Jonathan B., and Jules H. Van Binsbergen. 2016. Assessing asset pricing models using revealed preference. *Journal of Financial Economics* 119: 1–23.

Bhatnagar, Chandra Shekhar, and Riad Ramlogan. 2012. The capital asset pricing model versus the three factor model: A United Kingdom Perspective. *International Journal of Business and Social Research* 2: 51–65.

Brailsford, Tim, Clive Gaunt, and Michael A O'Brien. 2012. Size and book-to-market factors in Australia. *Australian Journal of Management* 37: 261–81.

Carter, Bradley, Chris Muller, and Mike Ward. 2017. The Applicability of Black's Variation of the Capital Asset Pricing Model (CAPM) in the South African Context. Available online: https://ssrn.com/abstract=2966770 (accessed on 29 October 2019).

Choudhary, Kapil, and Sakshi Choudhary. 2010. Testing Capital Asset Pricing Model: Empirical Evidences from Indian Equity Market. *Eurasian Journal of Business and Economics* 3: 127–38.

Daniel, Kent, Sheridan Titman, and K. C. John Wei. 2001. Explaining the Cross-Section of Stock Returns in Japan: Factors or Characteristics? *The Journal of Finance* 56: 743–66.

Fama, Eugene F., and Kenneth R. French. 1996. Multifactor Explanations of Asset Pricing Anomalies. *Journal of Finance* 51: 55–84.

Fama, Eugene F., and James D. MacBeth. 1973. Risk, Return and Equilibrium: Empirical Tests. *Journal of Political Economy* 81: 607–36.

Furman, Edward, and Ricardas Zitikis. 2017a. An adaptation of the classical CAPM to insurance: The weighted insurance pricing model. In *Casualty Actuarial Society E-Forum*. Spring. Available online: https://www.researchgate.net/publication/315772866_An_adaptation_of_the_classical_CAPM_to_insurance_the_Weighted_Insurance_Pricing_Model (accessed on 8 April 2020).

Furman, Edward, and Ricardas Zitikis. 2017b. Beyond the Pearson correlation: Heavy-tailed risks, weighted Gini correlations, and a Gini-type weighted insurance pricing model. *ASTIN Bulletin: The Journal of the IAA* 47: 919–42.

Gharghori, Philip, Ronald Lee, and Madhu Veeraraghavan. 2009. Anomalies and stock returns: Australian evidence. *Accounting & Finance* 49: 555–76.

Lintner, John. 1965. The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *The Review of Economics and Statistics* 47: 13–37.

Markowitz, Harry. 1952. Portfolio Selection. *The Journal of Finance* 7: 77–91.

Mollik, Abu T. 2014. The CAPM and risk-return anomalies in Asian emerging markets: Evidence from Bangladesh and Malaysia. Paper presented at 11th Asian Business Research Conference, Dhaka, Bangladesh, December 26–27, pp. 1–24.

Nguyen, Thang Cong, Tan Ngoc Vu, Thanh Trung Do, Vuong Minh Nguyen, and Duc Hong Vo. forthcoming. Systematic Risk in the Asia Pacific Region a Clinical death? *Review of Pacific Basin Financial Markets and Policies*.

O'Brien, Michael A., Tim Brailsford, and Clive Gaunt. 2008. Market Factors in Australia. Paper presented at Australasian Finance and Banking Conference, Sydney, Australia, December 12–16.

Oke, Babatunde Oke. 2013. Capital Asset Pricing Model (CAPM): Evidence from Nigeria. *Research Journal of Finance and Accounting* 4: 17–26.

Olakojo, Solomon, and Kazeem Bello Ajide. 2010. Testing the Capital Asset Pricing Model (CAPM): The Case of the Nigerian Securities Market. *International Business Management* 4: 239–42.

Pettengill, Glenn N., Sridhar Sundaram, and Ike Mathur. 1995. The Conditional Relation between Beta and Returns. *The Journal of Financial and Quantitative Analysis* 30: 101–16.

Powell, Robert J., and Duc Hong Vo. 2020. A Comprehensive Stability Indicator for Banks. *Risks* 1. doi:10.3390/risks8010013.

Savor, Pavel G., and Mungo Wilson. 2014. Asset Pricing: A Tale of Two Days. *Journal of Financial Economics* 113: 171–201.

Sharpe, William F. 1964. Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance* 19: 425–42.

Tran, Phu Ngoc, Thang Cong Nguyen, Duc Hong Vo, and Michael McAleer. 2019. Market risk analysis of energy in Vietnam. *Risks* 4. doi:10.3390/risks7040112.

Tanga, Gordon Y.N., and Wai C. Shumb. 2003. The conditional relationship between beta and returns: recent evidence from international stock markets. *International Business Review* 12: 109–26.

Vo, Duc Hong. 2015. Which Factors Are Priced? An Application of the Fama French Three-Factor Model in Australia. *Economic Papers* 34: 290–301.

Vo, Hai Long and Duc Hong Vo. 2019. Application of Wavelet-Based Maximum Likelihood Estimator in Measuring Market Risk for Fossil Fuel. *Sustainability* 10. doi:10.3390/su11102843.