Do the asset pricing factors predict future economy growth? An Australian study.

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Abstract

In this paper we examine whether past returns of the market portfolio (MKT), the size portfolio (SMB), the book-to-market portfolio (HML) and the idiosyncratic volatility portfolio (HIMLI) can predict growth rates of ten major Australian economic indicators from 1993 to 2010. We find that all four factors can be used to predict growth rates in Australian economic indicators. We also find high returns of SMB and HML portfolios precede periods of good states of the macro economy, although high returns of HIMLI portfolio precede periods of bad states of the macro economy.

JEL Classification: G11; G12; G15

Keywords: Fama and French three-factor; Size; Book-to-market; Idiosyncratic volatility; Economic growth; Australia**Contact Authors:**
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1 Introduction

Asset pricing theories suggest that stock market information, for example, stock prices and returns, reflect investors' expectations about the future earnings of companies. As company earnings are included in GDP and are highly correlated with other major economic indicators, such as company gross profit, CPI, imports and exports, etc, the implication is that the stock market information may contain information about future economic growth. Thus, stock prices may predict future economic growth.

In support of this notion, a number of previous studies have found that stock market information predicts economic activity. For example, Fama (1981) finds that stock returns lead growth rates of GNP, capital expenditures, the return on capital and output. Fama (1981) suggests that since current prices for securities are formed based on rational expectations about forecasts of real variables, stock prices/returns may predict future economic activities. Indeed, the leading role of stock market information has attracted considerable attention in the literature and papersinclude Moore (1983), Fischer and Merton (1985), Barro (1990), Estrella and Mishkin (1998), Aylward and Glen (2000), Hassapis and Kalyvitis (2002), Panopoulou (2007), and Ibrahim (2010). In general, these studies provide further evidence to support that stock market information leads economic activities.

Moreover, Liew and Vassalou (2000) find that stock market return based asset pricing factors, such as the Fama and French size factor (hereafter SMB) and book-to-market factor (hereafter HML), predict future economic growth across 10 developed countries including Australia. Liew and Vassalou (2000) suggest that SMB and HML are state variables in context of Merton's (1973) intertemporal capital asset pricing model. As state variables, these return based asset pricing factors are related to the economic activities.

Interestingly, recent studies in the area of asset pricing also find that idiosyncratic volatility is a significant asset pricing factor for stock returns in the presence of Fama and French three-factor model. For example, Ang et al. (2006, 2009) and Fu (2009) show that idiosyncratic volatility is priced in the US and internationally. Liu and Di Iorio (2012) find that the return of idiosyncratic volatility mimicking portfolio is priced for Australian stock returns. Idiosyncratic volatility is commonly measured as the standard deviation of the regression residual from the Fama and French three-factor model and it contains different information which is not captured by Fama and French three-factor. Hence, we are motivated to examine

the information content of idiosyncratic volatility in predicting the future growth rate of ten different aspects of the Australian economy.

Liew and Vassalou (2000) successfully linked the return based asset pricing factors to the future growth rate of GDP and they find that SMB predicts future economic growth for Australia from 1985 to 1996. We are motivated to study the predictive role of idiosyncratic volatility and the three Fama and French factors to the future growth rate of Australian economy. In this paper, we contribute to the literature by examining the predictive power of Australian stock return based on the Fama and French three-factor (MKT, SMB and HML) and an idiosyncratic volatility mimicking factor (hereafter HIMLI) to the growth rates of ten Australian economic indicators, including company gross profit index, consumer price index, export price index, effective foreign exchange rate, GDP, import price index, industrial production index, M1, treasury bond rate and unemployment rate index. We presumably expect that positive relationships between the asset pricing factors and the growth rates of company gross profit index, consumer price index, export price index, GDP, import price index, industrial productions index and M1 as positive growth rates of these economic indicators represent good news, so investors should buy stocks before good news arrives into the market. We also expect a negative relationship between the asset pricing factors and the effective foreign exchange rate (TWI) and the unemployment rate index because positive growth rates of these two economic indicators represent bad news, and therefore the implication is that investors should sell stocks if they expect bad news will arrive into the market. Further, we estimate the lagged returns of SMB, HML and HIMLI portfolios during good and bad states of the economy.

Our results indicate that the MKT, SMB, HML and HIMLI factors predict growth rates of Australian macroeconomic indicators, but MKT explains a greater number of the economic indicators than SMB, HML and HIMLI. The explanatory power of MKT is also more stable than SMB, HML and HIMLI as we find stable positive relationships between MKT and the growth rates of company gross profit, the export price index, GDP, the import price index and we find a stable negative relationship between MKT and the effective exchange rate and the unemployment rate. This finding may suggest that investors do not follow trading strategies of buy small stock and sell big stocks, buy high book-to-market equity ratio stocks and sell low book-to-market equity ratio stocks, and buy high idiosyncratic volatility stocks and sell low idiosyncratic volatility stocks even though they expect good economic news will arrive

into the market. Instead, investors buy a number of stocks which are similar to the composition of the market portfolio (MKT) when they expect good economic news will arrive into the market and they sell a number of stocks which are similar to the composition of the market portfolio when investors expect bad economic news.

The portfolio performance analysis shows that high past returns of SMB and HML portfolios precede periods of good states of the economy, but low past returns of HIMLI precede period of good states of the economic indicators. This is an interesting finding as current stock prices reflect investors' expectations of future company earnings, and these earnings are highly correlated with the economic indicators. Therefore, high returns of the stock market factors should precede periods of high growth rate of the economic indicators. The negative relationship between past returns of the HIMLI portfolios and future growth rates of the economic indicators contradicts the theory. However, this negative relationship may be explained by the asymmetric behaviour of idiosyncratic volatility as idiosyncratic volatility increases significantly during bad stock market time but reduces marginally during good market times. Therefore investors require higher returns to compensate the higher idiosyncratic volatility during bad stock market states, but they require lower returns to compensate the lower level of idiosyncratic volatility during good stock market states. Tthe difference between high idiosyncratic volatility portfolios and low idiosyncratic volatility portfolios is bigger during bad stock market times than during good stock market times. Hence a negative relationship between past returns of HIMLI and future growth rate the economy is observed.

The reminder of this paper is organized as follows. Section 2 reviews the previous literature. Section 3 outlines the methodology employed in this study. Section 4 describes the data. Section 5 presents the empirical test results and results discussion. Section 6 provides the conclusion.

2 Literature review

2.1 The relationship between stock market information and macroeconomic activities

Economic theory suggests that stock returns based factors are leading indicators of economic activity. Previous studies provide substantial evidence to support that stock returns predict economic activities. Fama (1981) find that US stock returns lead growth rates of GNP and

other real variables including capital expenditures, the real rate of return on capital and output. They suggest that the stock market expectations are rational forecasts of the real sector. Moore (1983) finds that stock prices are leading indicators for business cycles for the period 1973 to 1975. Fischer and Merton (1984) confirmed Moore's (1983) finding and suggest that the stock prices predict the business cycles and the GNP during period 1950 to 1982. They also find that stock prices lead growth rate of investment and consumption. Barro (1990) find that lagged changes of US stock prices predict the growth rate of investment activity during the period 1891 to 1987. Barro (1990) also documented similar findings for Canada. This study further linked the stock market information and macroeconomic activities. Barro (1990) provides evidence to support that stock market information is a rational forecast of the macroeconomic activity. More recently, Estrella and Mishkin (1998) find that stock prices predict US recessions within in three quarter horizons during the period 1959 to 1995. Their finding further confirmed that the stock prices contain information in relation to the future macro economic activities.

Various studies conclude that the stock market contains information about future economic activity. For example, a link between future growth rate of macro economy and past returns and returns of Fama and French three factors is established. Liew and Vassalou (2000) find that Fama and French three-factor predict future growth rates of GDP. They find that SMB and HML predict future GDP growth in many developed countries including Australia. Their results provide evidence to support that the Fama and French three factors are state variables in the context of Merton (1973) intertemporal capital asset pricing model. The relationship between stock market information and economic activity has been studied internationally. For example, Aylward and Glen (2000) extend their study to 23 countries including Australia. They find stock prices are leading indicators for investment, GNP and consumption for various countries over the period 1951 to 1993, but the predictive power of the stock prices changes across countries in the sample. Hassapis and Kalyvitis (2002) investigate the link between real stock price changes and economic growth for G-7 countries. They find that real stock price changes are related to the growth rate of output. The predictive power of the stock market information is further confirmed in Europe. Panopoulou (2007) examines the predictive power of stock market returns to the growth of the Euro area. Panaopoulou (2007) finds that stock market returns is the single most powerful predictor when compared to short-term interest rates, interest rate spreads and the future economic expectations in 12 European countries. More recently, the predictive power of the stock market information to

macroeconomic activities is examined in Asia-Pacific countries. For example, Ibrahim (2010) examined the predicative power of stock market returns to the growth rate of outputs in Malaysia. Ibrahim (2010) further provided evidence to show that stock market returns predict real output at short horizons, specifically less than 4-quarter horizon for the period 1978 to 2008.

Despite the fact that a substantial number of empirical studies support that stock market information predicts macroeconomic activities, a few contrary findings have been reported in the literature. Stock and Watson (1990) find that the predictive power of the stock returns to economic growth is not stable over time in the US for the period 1959 to 1988. Binswanger (2000) provides evidence to show that the predictive power of the stock returns to subsequent real activities disappeared in the US in early 1980's. Binswanger (2001) find similar results for Japan.

2.2 Fama and French three-factor model and risk mimicking factor for idiosyncratic volatility

Fama and French (1993) construct a three-factor model and they find that the three-factor model explain the stock returns in US. The three factors are a market factor (MKT), a size factor (SMB) and book-to-market equity ratio factor (HML). The market factor is the returns of the market proxy minus the risk-free rate, the size factor is the returns of small company portfolio minus the returns of big company portfolio and the book-to-market equity ratio factor is the returns of high book-to-market equity ratio company portfolio minus the returns of low book-to-market equity ratio company portfolio.

Previous studies in the area of asset pricing suggest that Fama and French three-factor model has strong explanatory power to the stock returns across countries on the world. For example, Fama and French (1993, 1995, 1996, and 1998) document that Fama and French three-factor model explains stock returns internationally.

A fourth factor, idiosyncratic volatility, has recently been considered. The motivation for this fourth factor is found in an underlying assumption of the Capital Asset Pricing Model, specifically thatunsystematic risk (or idiosyncratic risk) is diversified away by holding a proportion of fully diversified market portfolio. Hence idiosyncratic volatilityis not priced in

asset returns. However, in reality, many investors hold under diversified portfolios for various reasons, for example investors are only aware of a small subset of available stocks available, thus conducting their trading activities within a market segments. As a consequence,Merton (1987) claims, idiosyncratic volatility should be priced for asset returns if investors hold under-diversified portfolios. Indeed, Goetzmann and Kumar (2004) find that more that 25% of investors hold one stock and less 10% of the investors hold more than 10 stocks. Campbell, Lettau, Malkiel and Xu (2001) suggest that investors must hold at least 50 randomly selected stocks in their portfolio in order to achieve diversification. Therefore, the role of idiosyncratic volatility as a potential significant asset pricing factor has been an area of interest amongst researchers.

Recent studies show that there is a significant relationship between idiosyncratic volatility and stock returns. For example, Ang et al. (2006) find a negative relationship between lagged idiosyncratic volatility and future stock returns in the US. In a subsequent study, Ang et al. (2009) find a negative relationship between lagged idiosyncratic volatility and future stock returns in 22 developed countries. Their empirical results support the assumption that investors hold under-diversified portfolios and therefore the notion that idiosyncratic volatility is priced. Implementing an augmented Fama-French model, Fu (2009) also reports a positive relationship between idiosyncratic volatility and stock returns in the US and hence finds that idiosyncratic volatility is a significant asset pricing factor in addition to the Fama and French three factors. More recently, Nartea, Ward and Yao (2011) find a positive relationship between idiosyncratic volatility and stock returns in Southeast Asian stock markets including Malaysia, Singapore, Thailand and Indonesia. Their findings suggest that the explanatory power of idiosyncratic volatility in stock returns is not country specific. Finally, Liu and Di Iorio (2012), also using an augmented Fama-French model, find that the return of idiosyncratic volatility mimicking portfolios explain Australian stock returns from 2002 to 2010. Hence as a significant asset pricing factor which contains the stock market information, idiosyncratic volatility may contain information about the macro economy that is not captured by the Fama and French three factors.

Finally, a link between Fama and French three-factor and the growth rate of GDP is established by Liew and Vassalou (2000). As Fama and French three-factor model is the one of the most important findings in the area of asset pricing, Liew and Vassalou (2000) provides motivation to further explore the relationship between these return based stock

market risk factors and the growth rates of macroeconomic indicators.. They find that the three Fama and French factors predict future growth rates of GDP. They report that SMB and HML predict future GDP growth in many developed countries including Australia. Our study is motivated by Liew and Vassalou (2000). In this paperwe construct the three Fama and French factors, and include a risk mimicking factor for idiosyncratic volatility in Australia. Specifically, following Liew and Vassalou (2000), we examine the predictive power of MKT, SMB, HML and HIMLI to ten major Australian economic indicators.

3 Methodology

3.1 Daily Fama and French risk mimicking portfolios and idiosyncratic volatility

In this study, we test whether risk mimicking quarterly Fama and French three-factors and the idiosyncratic volatility factor predict the growth rate of ten key economic indicators in Australia. At the early state of our study, we estimate monthly idiosyncratic volatilities for stocks by constructing daily Fama and French risk mimicking portfolios. Following Ang et al (2009), we define idiosyncratic volatility as the standard deviation of regression residuals of the Fama and French (1993) three-factor. In order to construct daily SMB and HML portfolios, we sort the stocks into two size portfolios and three book-to-market equity ratio portfolios. The two size portfolios comprise the top 50% of companies (big) by market capitalization and the bottom 50% companies (small) by market capitalization. The three book-to-market equity ratio portfolios comprise top 1/3 companies (high) by book-to-market equity ratio, medium 1/3 companies by book-to-market equity ratio and bottom 1/3 companies (low) by book-to market equity ratio. These portfolios are rebalanced on an annual basis. At the end of year, the companies are ranked and sorted into the six portfolios according to their size and book-to-market equity ratio in December of year t-1. SMB is calculated as the return of the small size portfolios minus the return of the big size portfolio. HML is calculated as the returns of the high book-to-market equity ratio portfolio minus the returns of the low book-to-market equity ratio portfolio.

3.2 Constructing monthly risk mimicking portfolios for size, book-to-market equity ratio and idiosyncratic volatility

Again, we follow Fama and French (1993) to construct monthly SMB and HML. The monthly SMB is estimated as the monthly returns of the small size portfolio minus the monthly return of big size portfolio. The monthly HML is estimated as the monthly returns of the high book-to-market equity portfolio minus the monthly returns of the low book-to-market equity portfolio.

We then follow Drew, Naughton and Veeraraghavan (2004) to construct the monthly risk mimicking portfolio HIMLI for idiosyncratic volatility. We sort the stocks into three portfolios according to their idiosyncratic volatilities. Three idiosyncratic volatility portfolios comprise 1/3 high idiosyncratic volatility companies, 1/3 medium idiosyncratic volatility companies and 1/3 low idiosyncratic volatility. The monthly idiosyncratic volatility factor HIMLI is estimated as the returns of high idiosyncratic volatility portfolio minus the returns of low idiosyncratic volatility portfolio. The idiosyncratic volatility portfolios are rebalanced on an annual basis. Every year t, the companies are ranked and sorted into three portfolios according to their idiosyncratic volatilities at the last month of the previous year.

Following the construction of the monthly SMB, HML and HIMLI, we convert these monthly asset pricing factors to quarterly data by taking average on three months of data in each quarter.

3.3 The predictive power of the asset pricing factors to future growth rates of economic indicators

3.3.1 Univariate regressions

Following Liew and Vassalou (2000), we first use univariate regression analysis to analyse the predictive power of the individual asset pricing factor to future economic growth. The regressions use quarterly data and the regression equation is as follows

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(Factor\ \mathrm{Re}turn_{(t-4,t)}) + \varepsilon_{(t,t+4)} \quad (1)$$

where *EconomyIndicator* is the quarterly growth rate of ten economic indicators for Australia, including company gross profit index, consumer price index (hereafter CPI), export price index, effective foreign exchange rate, GDP, import price index, inflation, industrial production index, job advertisement index, M1, treasury bond rate and unemployment rate index; $Factor\ \mathrm{Re}turn$ is either MKT, SMB, HML or HIMLI; and ε is the regression residual.

The macroeconomic indicators generally have quarterly frequency, so serial correlation and heteroskedasticity in the regression residuals are suspected. Following Liew and Vassalou (2000), we use the Newey and West (1987) estimator to control for these potential data problems.

3.3.2 Bivariate regressions

We use bivariate regression analysis to test whether SMB, HML and HIMLI contain the same information as the MKT. The regression equation is the following:

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(Factor\ \mathrm{Re}turn_{(t-4,t)}) + \varepsilon_{(t,t+4)} \quad (2)$$

Where *EconomyIndicator* is the growth rate of each of the twelve Australian economic indicators; MKT is the quarterly market premium or excess return of the market portfolio over the risk free rate; $Factor\ \mathrm{Re}turn$ is SMB, HML or HIMLI; and ε is the regression residual.

3.3.3 Multivariate regressions

We use multivariate regression analysis to examine the information contentof MKT, SMB, HML and HIMLI with regard to future economic growth in Australia. The regression results will provide an insight into which model can predict which economic indicator for Australia. The regression equations are as follows:

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(SMB_{(t-4,t)}) + \delta(HML_{(t-4,t)}) + \varepsilon_{(t,t+4)} \quad (3)$$

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(SMB_{(t-4,t)}) + \delta(HIMLI_{(t-4,t)}) + \varepsilon_{(t,t+4)} \quad (4)$$

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(HML_{(t-4,t)}) + \delta(HIMLI_{(t-4,t)}) + \varepsilon_{(t,t+4)} \quad (5)$$

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(SMB_{(t-4,t)}) + \delta(HML_{(t-4,t)}) + \lambda(HIMLI_{(t-4,t)}) + \varepsilon_{(t,t+4)} \quad (6)$$

3.3.4 Portfolio performances at different states of the economic indicators

We sort the past one year returns of SMB, HML and HIMLI portfolios by 'good state' and 'bad state' of next one year growth rate of twelve economic indicators. Following Liew and Vassalou (2000), we define a 'good state' of the economic indicator as those states exhibiting the highest 25% of future growth, and we define a 'bad state' of the economic indicator as those states exhibiting the lowest 25% of future growth. The results reveal the relationship between the past four quarters' returns of SMB, HML and HIMLI portfolios and the next four quarters' growth rate of twelve Australian economic indicators.

4 Data

The sample period for this study is January 1993 to December 2010. We obtained Australian stock return, market to book equity value and stock capitalisation data and the indices of ten major economic indicators from Datastream. We also obtained the 90-day Australian Bank Accepted Bill Rate from the website of Reserve Bank of Australia to represent a proxy for the risk free rate in Australia. We use the ASX All Ordinaries Total Return Index to represent the market portfolio proxy for Australia. The ten Australian major economic indicators include company gross profit index, consumer price index, export price index, effective foreign exchange rate, GDP, import price index, industrial production index, M1, treasury bond rate and unemployment rate index.

Our sample includes both active and dead stocks listed on the ASX during the sample period. To calculate monthly idiosyncratic volatility, we constructed daily Fama and French book-to-market factor and size factor and then we extracted the regression residuals to calculate the monthly idiosyncratic volatility. In order to avoid thin trading effects, following Guant (2004) we require that stocks must have at least one trade in a month. We also exclude the stocks from our sample if the stocks do not have the following available data during the sample period: daily and monthly total return, monthly market capitalization and monthly market to book value.

Table 1 summarizes the number of stocks in the final sample and their average returns, average size, average book-to-market equity value and average idiosyncratic volatility over our sample period. We had the least number of stocks (422) in 1993 and the largest number of stocks (1173 stocks) in 2008.

[Insert Table 1 here]

The data for all ten economic indicators are quarterly. Table 2 shows the descriptive statistics for the growth rates of the ten economic indicators used in the regression equations as dependent variables. The ten economic indicators exhibit a common characteristic of macroeconomic data as they are non-stationary. In order to make these data stationary we adjusted each economic indicator by taking the difference of the log of every series. Following these adjustments, we calculated the growth rates of the economic indicators.

[Insert Table 2 here]

The returns of the asset pricing factors are monthly. We converted the monthly asset pricing factors to quarterly frequency by taking the average of three monthly observations in the quarter. Table 3 shows the descriptive statistics of the quarterly asset pricing factors, namely the market factor, the size factor, the book-to-market factor and the idiosyncratic volatility factor. We use these asset pricing factors as the independent variables in our regression analysis.

[Insert Table 3 here]

5 Empirical results

5.1 The relationship between the asset pricing factors and the future growth rate of economic indicators by using univariate regression analysis

Table 4 reports the results of the univariate regressions of the future growth rate of Australian economic indicators on past returns of the MKT, SMB, HML or HIMLI.

[Insert Table 4 here]

In panel A, seven of the ten coefficients are statistically significant when we use MKT as the independent variable. The regression equations for the consumer price index, industrial production and the Treasury bond rate produce insignificant coefficients which suggest that past returns of MKT do not predict the growth rates of these economic indicators. Five of the seven significant coefficients have positive signs which suggest a positive relationship between past returns of MKT and future the growth rate of company gross profit, export price index, GDP, import price index, and M1 respectively. This may suggest that investors buy stocks when they expect these economic indicators will grow at a faster rate in the future because generally faster growth rates for these economic indicators can be interpreted as good news in the economy. Two of the seven significant coefficients exhibit a negative sign which indicates a negative relationship between the past return of MKT and the future growth rate of the effective foreign exchange rate and the unemployment rate. This may indicate that investors sell stocks when they expect the growth rate of these economic indicators will increase in the future as increases in their growth rate of may be interpreted as bad news in the economy.

The coefficients of determination (R-squared) are between 6.6% (inflation) and 40.4% (export price index) for the significant regression coefficients. This suggests that proportions of variation in the growth rate of the economic indicators are explained by the model.

Three of the ten coefficients are statistically significant when SMB is the independent variable. The three coefficients exhibit positive signs which suggests a positive relationship between past returns of SMB and the future growth rate of the export price index, GDP, and the import price index. This is consistence with the findings of Liew and Vassalou (2000) who suggest high returns of SMB precede periods of high economic growth. Moreover, three of the ten coefficients are statistically significant when HML is used as the independent variable. For the case of effective foreign exchange rate, the slope coefficient exhibits a positive sign. In the case of the import price index and M1, the slope coefficients are negative.

Five of the ten slope coefficients are statistically significant when HIMLI is the independent variable. The five slope coefficients show positive signs which suggest that there is a positive

relationship between past returns of HIMLI and the growth rates of consumer price index, export price index, import price index, industrial production and M1.

However, the Durbin-Watson statistics of the univariate regressions indicate autocorrelation in our model. In order to correct this problem, we put an AR(1) term into our models, and we report our results in Panel B of Table 4. We note that the number of significant coefficients for MKT decreases to six out of ten compared to seven out of ten in Panel A of Table 4. Further, we do not note a large change in the magnitude of the significant coefficients of MKT compared to Panel A of Table 4. In addition, the signs of the significant coefficients remain the same, which suggest the relationship between MKT and the respective economic indicators is stable.

There is one significant coefficient for SMB - the consumer price index. . This indicates that high returns of SMB precede a high export price index because generally a high export price index can be interpreted as a good new in the economy. There are two significant coefficients for HML in Panel B of Table 4. The coefficients of HIML are significant when the consumer price index and the effective exchange rate are the dependent variables. Both significant coefficients of HML have positive signs which indicates that high return of HML also precede high growth rates of consumer price index and effective foreign exchange rate. The number of significant coefficients for HIMLI decreases to 2 compared to five in Panel A of Table 4. The coefficients of HIMLI are significant when the export price index and GDP are the dependent variables. Both coefficients have positive signs which suggests that high returns of HIMLI precede high growth rates of export price index and GDP.

In Panel B of Table 4, we can see that the value of adjusted R-squared improves significantly after we add an AR(1) term into the regression model and the Durbin-Watson statistics suggest that autocorrelation is not a serious problem. Overall, our univariate regression analysis shows that returns of MKT contains most information among the four asset pricing factors but returns of SMB, HML and HIMLI also contain information in relation to the future growth rates of the economic indicators.

5.2 **The relationship between the asset pricing factors and future growth rate of economic indicators by using bivariate regression analysis**

The results of the univariate regression analysis suggest that MKT contains more information in relation to future growth rate of the economic indicators than other SMB, HML and HIMLI. In this section, we examine the information content of SMB, HML or HIMLI in the presence of MKT by using bivariate regression analysis.

Table 5 shows the results of bivariate regressions analysis. In Panel A, Model 1 of Table 5 shows that in the presence of MKT, the slope coefficients of SMB remain significant and have a positive sign. The past returns of MKT have a strong predictive power for the future growth rateof seven out of ten Australia economic indicators. This is consistent with the results of univariate regression analysis in Panel A of Table 4. In the presence of MKT, three out of ten slope coefficients remain statistically significant which suggests that the information content of SMB is different to the information content of MKT.

[Insert Table 5 here]

The results of Model 2 are presented in Table 5 and report that there are four out ten slope coefficients of HML that remain statistically significant in the presence of MKT and the number of significant slope coefficients of HML increase to four compared with three significant slope coefficients for the univariate regression analysis. This suggests that the predictive power of HML improves in the presence of MKT. However, there are not large changes in the magnitude of the coefficients of HML and there is no change in the sign of the significant coefficients for HML in the presence of MKT.

The results of Model 3 reported in Table 5 shows that three out of ten slope coefficients of HIMLI remain statistically significant in the presence of MKT compared to five significant coefficients for the univariate regressions in Panel A of Table 4. The bivariate regression results suggest MKT, SMB, HML and HIMLI contain information about future growth rates of economic activities. However, the low Durbin-Watson statistics suggest that autocorrelation exists in the models. In Panel B of Table 5, we run the same bivariate regressions again in presence of an AR(1) term.

In Panel B of Table 5, the coefficients of MKT remain stable in the presence of an AR(1) term except the coefficient of MKT, which becomes insignificant when M1 is a dependent variable.. However, SMB, HML and HIMLI explain a fewer number of economy indicators

in the presence of an AR(1) term. These results suggest that MKT explain a larger number of economic indicators than SMB, HML an HIMLI even in the presence of an AR(1) term and the explanatory power of MKTis more stable than SMB, HML and HIMLI.

5.3 **The relationship between the asset pricing factors and future growth rate of economic indicators using multivariate regression analysis**

The multivariate regression results are presented in Table 6.

[Insert Table 6 here]

Table 6 shows the relationships between future growth rate of Australian economic indicators and past returns of MKT, SMB, HML and HIMLI. In Panel A of Table 6, we summarize the results of multivariate regressions without AR(1) term and in Panel B of Table 6 we summarize the results of multivariate regressions with AR(1) term. In both Panel A and B, the sign and magnitude of the slope coefficients of MKT are relatively stable. In Panel A, the coefficients of MKT remain statistically significant in seven out of ten cases. In Panel B, the coefficients of MKT remain statistically significant in six out of ten cases. The coefficients of MKT have negative signs in the case of the effective foreign exchange rate and the unemployment rate as dependents variables. These findings are consistent with the regression results of Table 4 and 5. In the presence of AR(1) term, none of the coefficients of SMB are significant, two out of ten slope coefficients of HML remain statistically significant and three out of ten slope coefficients of HIMLI remain statistically significant. Again, the results suggest that MKT explains a larger number of the economic indicators than SMB, HML and HIMLI. SMB does not explain future growth of the economy in the multivariate regressions.

5.4 **Portfolios performance at different states of the economic indicators**

Table 7 reports the performance of the SMB, HML and HIMLI portfolios during good states and bad states of the Australian economic indicators.

[Insert Table 7 here]

High returns of the SMB portfolio precede periods of high growth rate of the economic indicators in seven out of ten cases. The positive relationships between past one year returns of SMB portfolio and one year ahead growth rates of the economic indicators are observed for company gross profit, consumer price index, export price index, GDP, industrial production, Treasury bond rate, and unemployment rate. On average, SMB portfolio generates 0.8% return during good states and 0.59% return during bad states. Generally, past one year returns of SMB are positively related to one year ahead growth rate of the economic.

High returns of theHML portfolio precede periods of high growth rate of the macro economy in five out of twelve cases. The positive relationship between past one year returns of HML portfolio and one year ahead growth rates of the economic indicators are observed for company gross profit, consumer price index, effective foreign exchange rate, GDP, Treasury bond rate. On average, HML portfolio generates 1.87% return during good states and 1.63% during bad states.

However, a negative relationship between past one year returns of HIMLI portfolio and one year ahead growth rate of the economic indicators is observed for five out of ten cases. On average, the HIMLI portfolio generates 1.13% return during good states and 1.37% return during bad time. The HIMLI portfolio generates higher (lower) return during bad (good) states of the macro economy. Generally, past one year returns of HIMLI are negatively related to one year ahead growth rate of the economy.

5.5 **The negative relationship between past returns of HIMLI portfolio and future growth rate of the economic indicators**

Generally, negative relationships between past one year returns of HIMLI portfolio and one year ahead growth rate of the economic indicators are observed. We generally expect positive relationships between past returns of the asset pricing factors and future growth rate of the economic indicators. The reason is that according to asset pricing theories, current stock prices reflect investors' expectations on future earnings of the companies, and the earnings of the companies are highly correlated with the economic indicators. Therefore, high returns of the stock market factors should precede periods of high growth rate of the economic indicators. However, we observe negative relationships between past returns of the HIMLI portfolio and the future growth rates of the economic indicators which contradicts the asset

pricing theories. In order to explain the negative relationships between past returns of HIMLI portfolio and future growth rates of the economic indicators, we further discuss the characteristics of idiosyncratic volatility of the stocks.

HIMLI is calculated as the returns of high idiosyncratic volatility stocks minus low idiosyncratic volatility stocks. The returns of high idiosyncratic volatility stocks and the returns of low idiosyncratic volatility stocks are the direct determinants of HIMLI. In theory, idiosyncratic volatility is the level of unsystematic risk which is not diversified away in the portfolios. Investors require extra compensation for the existing idiosyncratic volatility in their portfolios. Previous studies suggest that idiosyncratic volatility increases significantly during bad stock market states but decreases marginally during good stock market states, for example, Ooi et al. (2009) suggest that behaviour of idiosyncratic volatility is asymmetric during different states of the stock market. Therefore, investors are expected to require higher returns to compensate the higher idiosyncratic volatility during bad stock market states, but investors require lower returns to compensate the lower level of idiosyncratic volatility during good stock market states. Hence, the difference between high idiosyncratic volatility portfolio and low idiosyncratic volatility portfolio is bigger during bad stock market time than good stock market time. Moreover, stock market states precede macro economic states, so in table 10 we observe a negative relationship between past returns of HIMIL and future growth rate of the economic indicators.

5.6 **Summary**

We examine the predictive power of the asset pricing factors, MKT, SMB, HML and HIMLI to ten Australian economic indicators. Overall, we conclude that past returns of MKT, SMB, HML and HIMLI predict future growth rates of various economic indicators in Australia. Of the four asset pricing factors, MKT contains more information. Generally, high returns of SMB and HML portfolios precede periods of high growth rate of the economic indicators, but high returns of idiosyncratic volatility portfolio precedes periods of low growth rate of the economic indicators.

6 Conclusion

We examine whether return based asset pricing factors, MKT, SMB, HML and HIMLI predict future growth rates of ten Australian economic indicators for the period 1993-2010 by using Australian stock market data. The empirical results suggest that all four return based asset pricing factors contain information in relation to future growth rate of Australian economy. SMB, HML and HIMLI contain independent information other than the information content MKT. The portfolio performance analysis shows that high returns of SMB and HML portfolios precede periods of high growth rate of the economic indicators, but high returns of idiosyncratic volatility portfolio precedes periods of low growth rate of the economic indicators.

Our empirical findings contribute to the literature on return based asset pricing factors and macroeconomic indicators in several ways. First, we extend time series regression analysis to ten different economic indicators. Second, we include a return based idiosyncratic volatility factor in our regression models. Third, our portfolio performance analysis shows high returns of idiosyncratic volatility portfolio precede periods of bad states of the economy due to

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Table 1: Yearly summary statistics

This table shows the average number of stocks, average monthly return, average size (in millions) of the companies, average monthly BE/ME, and average monthly idiosyncratic volatility over the sample period.

Summary Statistics

Year	Number of Stocks	Return	Size	BEME	Idiovol
1993	422	0.0628	474	0.8564	0.1620
1994	480	0.0152	524	0.6741	0.1540
1995	529	0.0261	490	0.7701	0.1463
1996	737	0.0351	415	0.7110	0.1606
1997	822	-0.0087	435	0.7763	0.1712
1998	862	0.0029	514	0.9112	0.1954
1999	888	0.0480	637	0.8776	0.1983
2000	980	0.0182	655	0.7970	0.2106
2001	1083	-0.0003	619	1.0780	0.2162
2002	1111	0.0035	603	1.0110	0.2032
2003	1141	0.0433	573	0.9398	0.1972
2004	1255	0.0227	634	0.7465	0.1638
2005	1380	0.0065	716	0.7481	0.1705
2006	1485	0.0313	797	0.7193	0.1839
2007	1612	0.0237	912	0.6014	0.1860
2008	1773	-0.0649	723	0.8178	0.2591
2009	1771	0.0736	617	1.2262	0.2556
2010	1746	0.0179	765	0.8234	0.1989

Table 2: Summary statistics of ten Australia macroeconomic indicators.

	Company profit	CPI	EXPORT	Effective exchange rate	GDP	IMPORT	IP	M1	T-BOND	Unemployment
Mean	0.0201	0.0062	0.0088	0.0048	0.0157	0.0002	0.0055	0.0207	-0.0048	-0.0104
Median	0.0220	0.0063	0.0034	0.0046	0.0170	-0.0009	0.0063	0.0230	-0.0195	-0.0126
Maximum	0.1548	0.0167	0.1491	0.1147	0.0353	0.1021	0.0408	0.0521	0.2500	0.1636
Minimum	-0.1119	-0.0042	-0.2312	-0.2093	-0.0154	-0.0659	-0.0246	-0.1474	-0.2918	-0.0755
Std. Dev.	0.0446	0.0043	0.0557	0.0443	0.0090	0.0299	0.0124	0.0253	0.0888	0.0360
Skewness	-0.0826	0.0194	-0.5502	-1.3701	-0.8303	0.5660	0.0434	-4.1548	0.1355	1.7919
Kurtosis	4.3013	3.1009	7.4177	9.3881	4.8478	3.7833	3.0786	28.4543	4.0278	9.5187
Jarque-Bera	4.6600	0.0345	61.3183	142.9380	18.2592	5.6062	0.0406	2121.0350	3.3422	163.7030
Probability	0.0973	0.9829	0.0000	0.0000	0.0001	0.0606	0.9799	0.0000	0.1880	0.0000
Sum	1.3039	0.4381	0.6248	0.3429	1.1118	0.0123	0.3877	1.4721	-0.3429	-0.7401
Sum Sq. Dev.	0.1274	0.0013	0.2168	0.1375	0.0056	0.0627	0.0107	0.0450	0.5515	0.0906
Observations	65	71	71	71	71	71	71	71	71	71

Table 3: Summary statistics of the market factor, the size factor, the book-to-market factor and the idiosyncratic volatility factor.

	MKT	SMB	HML	HIMLI
Mean	0.004873	0.009392	0.018831	0.016075
Median	0.006639	0.007473	0.016954	0.023782
Maximum	0.068494	0.059759	0.074452	0.208122
Minimum	-0.114416	-0.022343	-0.023987	-0.088342
Std. Dev.	0.025644	0.018254	0.019238	0.049354
Skewness	-1.446069	0.510173	0.400691	0.751997
Kurtosis	8.689823	3.118737	3.349261	5.050017
Jarque-Bera	122.2156	3.165617	2.292588	19.3937
Probability	0	0.205397	0.317812	0.000061
Sum	0.350822	0.676207	1.355825	1.157397
Sum Sq. Dev.	0.046691	0.023659	0.026278	0.172942
Observations	72	72	72	72

Table 4: Univariate regressions result of major economic indicators on past four-quarters of asset pricing factor returns

The dependent variables are ten major Australian economic indicators. The independent variables are portfolios returns including MKT, SMB, HML and HIMLI. MKT is the excess return on the accumulative ASX All Ordinary Index, SMB is Fama and French risk factor mimicking portfolio for size, HML is Fama and French risk factor mimicking portfolio for book-to-market equity ratio and HIMLI is a risk factor mimicking portfolio for idiosyncratic volatility. Serial correlation and heteroskedasticity in the residuals of the regressions is controlled by using Newey and West (1987) estimator.

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(Factor\ \mathrm{Re}turn_{(t-4,t)}) + \varepsilon_{(t,t+4)}$$

Panel A

Economy indicators	Slope coefficients				T-values				R-Squared				Durbin-Watson Stat			
	MKT	SMB	HML	HIMLI	MKT	SMB	HML	HIMLI	MKT	SMB	HML	HIMLI	MKT	SMB	HML	HIMLI
Company gross profit	0.81	0.38	0.01	0.02	3.73	1.20	0.03	0.14	29.2%	4.0%	0.0%	0.0%	0.68	0.58	0.53	0.53
Consumer price index	0.04	0.03	0.05	0.04	1.56	0.61	1.25	2.05	2.8%	0.8%	5.8%	9.8%	0.24	0.23	0.22	0.27
Export price index	1.47	1.44	-0.44	0.54	7.36	4.75	-1.28	4.26	40.4%	22.4%	3.7%	20.8%	0.53	0.52	0.43	0.52
Effective exchange rate	-0.65	-0.17	0.74	-0.13	-2.91	-0.51	3.32	-0.95	16.4%	0.7%	21.3%	2.7%	0.50	0.45	0.59	0.46
GDP	0.23	0.17	0.05	0.05	3.40	2.72	1.24	1.62	36.3%	11.9%	1.8%	5.6%	0.50	0.37	0.34	0.33
Import price index	0.68	0.46	-0.59	0.20	4.08	1.77	-2.69	1.80	25.3%	6.6%	18.8%	8.8%	0.44	0.39	0.47	0.42
Industrial Production	0.05	0.02	-0.12	0.07	0.67	0.29	-1.52	2.85	1.6%	0.1%	9.4%	11.5%	0.54	0.52	0.56	0.59
M1	0.32	0.27	-0.44	0.19	3.67	0.90	-2.67	2.00	10.5%	4.1%	19.4%	14.1%	0.46	0.40	0.55	0.43
Treasury bond rate	-0.13	-0.19	0.36	-0.11	-0.25	-0.39	0.95	-0.48	0.2%	0.2%	1.6%	0.5%	0.66	0.65	0.68	0.66
Unemployment rate	-0.86	-0.04	0.17	0.00	-2.87	-0.13	0.68	0.00	20.4%	0.0%	0.8%	0.0%	0.29	0.23	0.24	0.23

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(Factor\ \mathrm{Re}turn_{(t-4,t)}) + AR(1) + \varepsilon_{(t,t+4)}$$

Panel B

Economy indicators	Slope coefficients				T-values				Adjusted R-Squared				Durbin-Watson Stat			
	MKT	SMB	HML	HIMLI	MKT	SMB	HML	HIMLI	MKT	SMB	HML	HIMLI	MKT	SMB	HML	HIMLI
Company gross profit	0.67	0.00	0.07	0.12	3.07	0.01	0.18	0.98	58%	51%	51%	52%	1.43	1.25	1.25	1.23
Consumer price index	0.00	0.00	0.05	0.01	0.19	-0.19	1.91	1.12	78%	78%	80%	78%	1.19	1.18	1.09	1.17
Export price index	1.35	0.89	-0.11	0.31	5.54	2.15	-0.24	2.34	72%	65%	62%	64%	1.30	1.03	0.87	1.08
Effective exchange rate	-0.56	-0.14	0.43	-0.06	-2.29	-0.49	2.05	-0.86	62%	59%	60%	59%	1.37	1.29	1.34	1.29
GDP	0.15	0.12	0.06	0.05	2.11	1.50	0.78	1.87	72%	70%	68%	70%	1.41	1.23	1.14	1.13
Import price index	0.54	0.25	-0.25	0.05	3.46	1.16	-1.28	0.83	71%	66%	66%	66%	1.40	1.32	1.26	1.31
Industrial Production	-0.02	0.01	-0.10	0.04	-0.23	0.12	-0.98	1.19	53%	53%	55%	54%	1.33	1.33	1.33	1.32
M1	0.10	0.17	-0.05	0.13	1.00	0.88	-0.32	1.29	64%	64%	64%	66%	1.35	1.40	1.33	1.39
Treasury bond rate	-0.45	-0.69	0.23	-0.16	-0.86	-1.29	0.39	-0.83	41%	42%	41%	41%	1.61	1.59	1.58	1.60
Unemployment rate	-0.41	0.36	-0.14	-0.06	-1.96	1.03	-0.47	-0.48	79%	78%	77%	78%	0.99	1.00	0.96	0.95

Table 5: Bivariate regressions of major economic indicators on past four-quarters of factors returns

The dependent variables are 10 major Australian economic indicators. The independent variables are portfolios returns including MKT, SMB, HML and HIMLI. MKT is the excess return on the accumulative ASX All Ordinary Index, SMB is Fama and French risk factor mimicking portfolio for size, HML is Fama and French risk factor mimicking portfolio for book-to-market equity ratio and HIMLI is a risk factor mimicking portfolio for idiosyncratic volatility. Serial correlation and heteroskedasticity in the residuals of the regressions is controlled by using Newey and West (1987) estimator.

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(Factor\ \mathrm{Re}turn_{(t-4,t)}) + \varepsilon_{(t,t+4)}$$

Panel A: model 1

Economy indicators	MKT		SMB			
	Slope	T-value	Slope	T-value	Adjusted R-squared	Durbin Watson
Company gross profit	0.785	3.38	0.182	0.53	27.6%	0.71
Consumer price index	0.035	1.51	0.017	0.40	0.0%	0.24
Export price index	1.307	6.34	1.107	3.61	51.7%	0.73
Effective exchange rate	-0.649	-2.82	-0.009	-0.03	13.6%	0.50
GDP	0.210	3.04	0.118	1.82	39.8%	0.56
Import price index	0.636	3.76	0.295	1.26	25.6%	0.47
Industrial Production	0.009	0.13	0.066	2.50	8.6%	0.54
M1	0.295	3.47	0.191	0.65	9.6%	0.47
Treasury bond rate	-0.107	-0.20	-0.158	-0.32	-2.9%	0.65
Unemployment rate	-0.889	-2.78	0.189	0.57	18.3%	0.30

Model 2

Economy indicators	MKT		HML			
	Slope	T-value	Slope	T-value	Adjusted R-squared	Durbin Watson
Company gross profit	0.902	4.61	0.281	0.86	30.1%	0.71
Consumer price index	0.062	2.28	0.075	1.62	9.8%	0.26
Export price index	1.485	7.52	0.047	0.14	38.5%	0.53
Effective exchange rate	-0.455	-2.52	0.594	2.86	26.1%	0.60
GDP	0.273	4.76	0.142	2.69	47.1%	0.65
Import price index	0.545	4.19	-0.407	-2.01	31.1%	0.51
Industrial Production	0.011	0.17	-0.117	-1.58	6.5%	0.56
M1	0.200	2.41	-0.376	-2.12	20.4%	0.57
Treasury bond rate	-0.013	-0.02	0.358	0.63	-1.6%	0.68
Unemployment rate	-0.905	-2.90	-0.133	-0.44	18.2%	0.29

Model 3

Economy indicators	MKT		HIMLI			Durbin Watson
	Slope	T-value	Slope	T-value	Adjusted R-squared	
Company gross profit	0.861	3.55	-0.096	-0.98	28.2%	0.69
Consumer price index	0.017	0.67	0.033	1.70	7.4%	0.28

Export price index	1.263	6.05	0.335	3.35	46.0%	0.67
Effective exchange rate	-0.629	-2.72	-2.721	-0.24	13.8%	0.51
GDP	0.221	3.18	0.010	0.43	34.5%	0.50
Import price index	0.614	3.75	0.105	0.99	25.0%	0.49
Industrial Production	0.009	0.13	0.066	2.50	8.6%	0.60
M1	0.228	2.38	0.154	1.52	16.1%	0.49
Treasury bond rate	-0.072	-0.13	-0.095	-0.41	-2.7%	0.66
Unemployment rate	-0.955	-3.09	0.152	1.41	20.1%	0.30

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(Factor\ \mathrm{Re}turn_{(t-4,t)}) + AR(1) + \varepsilon_{(t,t+4)}$$

Panel B:model 1

Economy indicators	MKT		SMB			
	Slope	T-value	Slope	T-value	Adjusted R-squared	Durbin-Watson
Company gross profit	0.71	3.14	-0.19	-0.61	58%	1.43
Consumer price index	0.01	0.24	-0.01	-0.26	78%	1.19
Export price index	1.27	5.19	0.56	1.75	73%	1.37
Effective exchange rate	-0.58	-2.15	0.07	0.24	62%	1.37
GDP	0.14	2.11	0.08	1.18	73%	1.44
Import price index	0.53	2.96	0.07	0.29	70%	1.42
Industrial Production	-0.02	-0.25	0.01	0.21	53%	1.33
M1	0.06	0.58	0.14	0.68	64%	1.39
Treasury bond rate	-0.33	-0.57	-0.56	-1.01	41%	1.62
Unemployment rate	-0.36	-1.89	-0.21	-0.68	79%	1.01

Model 2

Economy indicators	MKT		HML			
	Slope	T-value	Slope	T-value	Adjusted R-squared	Durbin-Watson
Company gross profit	0.72	3.21	0.24	0.67	58%	1.42
Consumer price index	0.01	0.52	0.06	1.90	79%	1.11
Export price index	1.38	5.23	0.16	0.39	72%	1.29
Effective exchange rate	-0.52	-2.20	0.34	1.90	63%	1.43
GDP	0.17	2.54	0.10	1.48	73%	1.45
Import price index	0.52	3.58	-0.17	-0.96	70%	1.43
Industrial Production	-0.03	-0.54	-0.11	-1.11	54%	1.33
M1	0.10	0.90	-0.03	-0.22	63%	1.35
Treasury bond rate	-0.42	-0.77	0.13	0.22	41%	1.61
Unemployment rate	-0.44	-2.24	-0.23	-0.80	79%	0.98

Model 3

Economy indicators	MKT		HIMLI			
	Slope	T-value	Slope	T-value	Adjusted R-squared	Durbin-Watson
Company gross profit	0.68	3.06	-0.01	-0.16	57%	1.43
Consumer price index	0.00	-0.17	0.01	1.16	78%	1.16
Export price index	1.28	5.06	0.10	1.17	72%	1.36
Effective exchange rate	-0.60	-2.04	0.05	0.45	62%	1.36
GDP	0.13	1.79	0.02	1.43	72%	1.39
Import price index	0.59	3.26	-0.06	-0.92	70%	1.33
Industrial Production	-0.06	-0.75	0.05	1.38	54%	1.33
M1	-0.03	-0.20	0.14	1.13	66%	1.38
Treasury bond rate	-0.38	-0.62	-0.10	-0.41	41%	1.62
Unemployment rate	-0.45	-2.16	0.04	0.40	79%	1.00

Table 6: Multivariate regressions of major economic indicators on past four-quarters of factors returns

The dependent variables are ten major Australian economic indicators. The independent variables are portfolios returns including MKT, SMB, HML and HIMLI. MKT is the excess return on the accumulative ASX All Ordinary Index, SMB is Fama and French risk factor mimicking portfolio for size, HML is Fama and French risk factor mimicking portfolio for book-to-market equity ratio and HIMLI is a risk factor mimicking portfolio for idiosyncratic volatility. Serial correlation and heteroskedasticity in the residuals of the regressions is controlled by using Newey and West (1987) estimator.

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(SMB_{(t-4,t)}) + \delta(HML_{(t-4,t)}) + \lambda(HIMLI_{(t-4,t)}) + \varepsilon_{(t,t+4)}$$

Panel A

Economy indicators	MKT		SMB		HML		HIMLI		Adjusted R-squared	Durbin-Watson
	Slope	T-value	Slope	T-value	Slope	T-value	Slope	T-value		
Company gross profit	0.885	3.99	0.468	1.83	0.135	0.40	-0.204	-2.18	31.6%	0.82
Consumer price index	0.050	1.76	-0.131	-2.12	0.125	2.57	0.077	3.00	30.0%	0.46
Export price index	1.245	5.33	0.996	2.33	-0.077	-0.32	0.085	0.65	50.6%	0.75
Effective exchange rate	-0.442	-2.31	-0.374	-0.93	0.700	3.80	0.125	0.76	25.4%	0.63
GDP	0.256	4.14	0.080	1.12	0.130	2.36	0.003	0.11	48.3%	0.68
Import price index	0.475	3.69	0.544	1.90	-0.522	-3.10	-0.077	-0.60	34.8%	0.58
Industrial Production	-0.010	-0.14	-0.108	-1.24	-0.067	-0.97	0.086	2.73	13.2%	0.61
M1	0.129	1.27	0.166	0.51	-0.372	-1.67	0.078	0.72	24.0%	0.61
Treasury bond rate	0.036	0.06	-0.277	-0.34	0.406	0.57	0.011	0.03	-4.6%	0.67
Unemployment rate	-0.975	-2.95	-0.022	-0.05	-0.072	-0.21	0.150	0.79	17.5%	0.30

$$EconomyIndicator_{(t,t+4)} = \alpha + \beta(MKT_{(t-4,t)}) + \gamma(SMB_{(t-4,t)}) + \delta(HML_{(t-4,t)}) + \lambda(HIMLI_{(t-4,t)}) + AR(1) + \varepsilon_{(t,t+4)}$$

Economy indicators	MKT		SMB		HML		HIMLI		Adjusted R-squared	Durbin-Watson
	Slope	T-value	Slope	T-value	Slope	T-value	Slope	T-value		
Company gross profit	0.71	2.83	-0.41	-1.19	0.27	0.76	0.11	1.08	57%	1.39
Consumer price index	0.00	0.08	-0.04	-1.35	0.06	2.15	0.02	1.97	79%	1.12
Export price index	1.30	4.86	0.59	1.36	0.09	0.26	-0.03	-0.30	72%	1.35
Effective exchange rate	-0.56	-1.95	-0.09	-0.25	0.35	2.08	0.08	0.56	62%	1.43
GDP	0.15	2.39	0.05	0.69	0.10	1.65	0.01	0.71	73%	1.45
Import price index	0.57	3.20	0.33	1.08	-0.19	-1.04	-0.14	-1.76	70%	1.35
Industrial Production	-0.07	-0.93	-0.10	-1.15	-0.09	-1.02	0.07	1.69	55%	1.31

M1	-0.03	-0.19	-0.17	-0.87	0.01	0.04	0.18	1.17	65%	1.35
Teasury bond rate	-0.33	-0.50	-0.84	-1.02	0.21	0.39	0.14	0.40	40%	1.62
Unemployment rate	-0.47	-2.62	-0.47	-1.45	-0.21	-0.73	0.15	1.47	79%	1.04

Table 7: Performance of the SMB, HML and HIMLI portfolios during good states and bad states of the Australian economic

We define "good states" as those states that exhibit the highest 25% of future growth, and "bad states" as those states that exhibit the lowest 25% of future growth. SMB, HML and HIMLI are annually rebalanced portfolios. SMB is Fama and French risk factor mimicking portfolio for size and calculated as the returns of small size portfolio minus big size portfolio. HML is Fama and French risk factor mimicking portfolio for book-to-market equity ratio and calculated as the returns of high book-to-market equity ratio portfolio minus the returns of low book-to-market equity ratio portfolio. HIMLI is a risk factor mimicking portfolio for idiosyncratic volatility and is calculated as the returns of high idiosyncratic volatility portfolio minus the returns of low idiosyncratic volatility portfolio.

Economic indicator	SMB			HML			HIMLI		
	Good states	Bad states	Difference	Good states	Bad states	Difference	Good states	Bad states	Difference
Company gross profit	0.78%	0.02%	0.76%	1.93%	1.27%	0.66%	0.83%	0.14%	0.69%
Consumer price index	0.91%	0.60%	0.31%	2.13%	1.03%	1.10%	1.82%	2.25%	-0.42%
Export price index	0.74%	0.01%	0.73%	1.87%	2.06%	-0.19%	0.72%	-0.88%	1.60%
Effective exchange rate	0.40%	0.82%	-0.42%	2.17%	1.63%	0.55%	-0.06%	0.15%	-0.20%
GDP	0.77%	0.56%	0.21%	1.71%	1.57%	0.14%	1.35%	1.82%	-0.46%
Import price index	0.82%	0.85%	-0.03%	1.73%	1.81%	-0.08%	0.49%	2.12%	-1.63%
Industrial Production	1.27%	-0.08%	1.36%	1.11%	1.87%	-0.76%	2.26%	0.52%	1.74%
M1	0.85%	1.11%	-0.26%	1.32%	2.44%	-1.12%	3.88%	1.47%	2.41%
Treasury bond rate	0.66%	0.66%	0.00%	3.02%	1.08%	1.94%	1.08%	1.63%	-0.55%
Unemployment rate	1.35%	0.56%	0.79%	0.86%	2.53%	-1.67%	2.56%	1.39%	1.16%
AVERAGE	0.80%	0.59%	0.21%	1.87%	1.63%	0.25%	1.13%	1.37%	-0.24%