

# A Best Choice Among Asset Pricing Models?

## The Conditional CAPM in Australia.

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**The Conditional CAPM in Australia.**

We use Australian data to test the Conditional CAPM (Jagannathan and Wang, 1996). Our results are generally supportive: the model performs well compared with a number of competing asset pricing models. In contrast to Jagannathan and Wang's study, however, we find that the inclusion of the market for human capital does not 'save' the concept of the time-independent market beta (it remains insignificant). We find support for the role of a "small-minus-big" factor (Fama and French, 1993) in pricing the cross-section of returns and find grounds to disagree with Jagannathan and Wang's argument that this factor proxies for misspecified market risk.

## 1.0 Introduction

Motivated by Fama and French's (1992) study finding that the "relation between market beta and average return is flat", JW (Jagannathan & Wang, 1996) revisited the performance of the CAPM with US data but, unlike Fama & French (1992), made specific allowance for the possibility that firm betas vary through time. The resulting tests rejected the "standard" CAPM (when firm betas were assumed stationary) but tests of the "Conditional CAPM" (where the effects of time-varying betas were accounted for) performed well. This Conditional CAPM (CCAPM) outperformed Chen, Roll and Ross' (1986) empirically derived version of the Arbitrage Pricing Theory (APT) and displayed a level of explanatory power similar to that of the Fama-French three-factor model (Fama and French, 1992, 1993).

Despite the success of JW's analysis, no study has examined the CCAPM outside the US. This study utilises Australian data and closely follows the methodology in JW (discussed in Section 3). Following JW, the CAPM and CCAPM are tested (Section 4 of the paper). The CCAPM is then tested against Fama & French's (1993) three-factor model (Section 5.1) and against the APT (Section 5.2). Consistency with the Black (1972) version of the CAPM is also investigated (Section 5.4). To this point we have a complete replication of the work of JW but, to extend the investigation into the Australian context, further tests are conducted to evaluate the influence of US market movements over Australian stock returns (Section 5.3). We provide an overview of pertinent literature in Section 2. Section 6 concludes the paper.

In keeping with JW's findings for the US market, we find that the explanatory power of the CAPM is poor (with an  $R^2$  of only 7.25%), but a marked improvement is noted when the

time-variation in betas is accounted for (the  $R^2$  is raised to 65.31%). The results imply that the assumption of time-invariant firm betas leads to a poorly specified test of the CAPM. In contrast to JW, we find that extending the market portfolio from the value-weighted index of stocks to include a measure of the return to human capital does little to improve the explanatory power of the model. Our analysis does not support JW's argument, regarding Fama and French's three-factor model, that the size and book-to-market variables may simply proxy for the risks associated with time-series beta variation and the return on human capital: in Australia, *SMB* retains high levels of significance in all the cross-sectional tests reported in this study. Like JW, we find that the CCAPM outperforms realizations of the APT. The CCAPM also outperforms models that hypothesise that returns are driven by US market forces. When CCAPM variables are added to these models, however, the resulting explanations are significantly better than those based on the CCAPM alone.

## 2.0 Asset Pricing Tests and the Conditional CAPM

Early tests of the static CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966) were broadly supportive of the predicted linear relationship of returns to systematic risk (Fama and MacBeth, 1973; Black, Jensen and Scholes, 1972). In Australia, Ball, Brown, & Officer (1976) found results consistent with the zero-beta CAPM.<sup>1</sup> In the US, subsequent research uncovered empirical regularities, such as the size effect (Banz, 1981), that were, on the face of it, difficult to reconcile with the CAPM paradigm.<sup>2</sup> Fama & French (1992) found no

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<sup>1</sup> After Roll (1977), the focus in Australian literature shifted to tests of mean-variance efficiency of market proxies. Stokie (1982) rejects mean-variance efficiency for a number of samples while later analyses provide inconclusive evidence (Wood, 1991; Faff, 1991).

<sup>2</sup> Australian studies have also found evidence of empirical regularities (Officer, 1975; Brown, Keim, Kleidon, & Marsh, 1983; Brailsford & Easton, 1991; Gaunt, Gray and McIvor, 2000).

evidence that market  $\beta$  was priced. Fama & French (1993) argue that the cross-section of returns can be modelled using three factors: a market factor and factors based on size and the ratio of book-to-market value of equity. It is safe to say that the 3-factor model has succeeded the CAPM as the paradigm within which asset prices are analysed.

Support for the 3-factor model's applicability in Australia is provided in Fama and French (1998), although the number of firms available for inclusion in their study was far fewer than those listed in Australia.<sup>3</sup> Halliwell, Heaney, & Sawicki (1999) found the size factor to be significant. Their results, however, were sensitive to the stocks that were included in the sample and the portfolio formation technique,<sup>4</sup> and the book-to-market factor was found to be statistically insignificant. In contrast to Halliwell et al. (1999), in Faff (2001) the book-to-market effect was found to be statistically significant but a negative risk premium was estimated for the size factor. It should be noted that Halliwell et al.'s sample ended in June 1991, while Faff used data from the period January 1991 to April 1999, and, rather than constructing factors, Faff proxies HML and SMB using commercially available measures.

Perhaps the failure of the CAPM is driven by the time-varying nature of asset betas<sup>5</sup> and market and risk-free premiums? To address this question, JW developed the CCAPM as a model of the cross-section of returns in which the value of a firm's beta is conditional on the state of the economy. Readers wishing a detailed understanding of the model should refer to

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<sup>3</sup> Maroney and Protopapadakis (2002), in a similar multi-country study, find less clear support for the 3-factor model.

<sup>4</sup> Their results differ for value or weighted portfolios.

<sup>5</sup> Bollerslev, Engle, & Wooldridge (1988); Harvey (1989), Ferson & Harvey (1991, 1993) and Ferson & Korajczyk (1995) provide US evidence in support of this. Australian evidence is provided by Faff, Lee, & Fry (1992); Brooks, Lee & Faff (1992); and Brooks, Faff, & Josev (1997).

JW, but the testable model ultimately derived, and the focus of this paper, is referred to as the Premium-Labour (PL) model (equation 1) and takes the form:

$$E[R_{it}] = c_0 + c_{VW}\beta^{VW} + c_{prem}\beta^{prem} + c_{labour}\beta^{labour}. \quad (1)$$

$R_{it}$  is the return<sup>6</sup> of asset  $i$  in period  $t$ ,  $\beta^{VW}$  is the market beta based on a value-weighted portfolio of all stocks,  $\beta^{prem}$  captures the systematic changes in a firm's beta with variation in the market premium, and  $\beta^{labour}$  is the beta for the human capital market. Whereas the conventional CAPM prices assets to compensate only for levels of systematic risk, the addition of the extra variable in (1) postulates that asset prices will be determined not only by an asset's systematic risk, but by the predictable component of the security's change in systematic risk when there are shifts in the state of the economy. Following Mayers (1972), the market portfolio of wealth is assumed to include not only stocks, but also human capital. The CAPM is nested as a special case (when the cross-sectional coefficients of  $\beta^{prem}$  and  $\beta^{labour}$  are equal to zero) allowing direct comparisons of the CCAPM and the standard CAPM.<sup>7</sup>

Using monthly US returns from July 1963 to December 1990, JW found that, when the CAPM was tested,  $c_{VW}$  was not significantly different from zero, and the  $R^2$  value was 1.35% when only  $\beta^{VW}$  was included in the model. However, adding in  $\beta^{prem}$  resulted in a statistically significant  $c_{prem}$  coefficient and increased the  $R^2$  to 29.32%. Adding  $\beta^{labour}$  further increased the

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<sup>6</sup> Following JW, "returns" are taken as price relatives,  $P_t/P_{t-1}$ , where  $P_t$  is the price of the security at time  $t$  adjusted for dividends and capitalization changes.

<sup>7</sup> JW note that, although a multiple-beta model is presented, the model is fundamentally different from either Merton's (1973) multi-beta intertemporal models, or Ross' (1976) Arbitrage Pricing Theory. Whereas Merton shows equilibrium to hold when returns are a linear function of *several* conditional betas, Jagannathan & Wang's model remains conditional upon only *one* beta; the market beta. The second beta is necessarily incorporated into the model when moving from a conditional to an unconditional formulation of the model. JW (pages 9 to 10 and 37 to 40) provide

$R^2$  to 55.21%. The PL model captured the size effect. In addition, JW compared the PL model to other prominent asset pricing models. Their results suggest that the PL model outperforms the APT model of Chen, Roll, & Ross (1986) and performs at least as well as Fama & French's three-factor model (suggesting that "the two Fama & French (1993) factors may proxy for the risk associated with the return on human capital and beta instability" - JW, p. 32). Although the data would suggest that the PL model is a significant improvement over the CAPM, there is still the somewhat contrary finding that the  $c_{VW}$  coefficient is statistically insignificant across all regressions. On the surface, this suggests that systematic risk is unimportant, whereas the predictable change in systematic risk is (i.e., the systematic risk of systematic risk is priced). That the  $c_{labour}$  term is often significant, however, is taken as an indication that the market may simply be better characterised by the return on human capital than by the return on common stocks.

### 3.0 Data and Methodology

To test equation 1, share price data for all listed Australian stocks were taken from the *Share Price & Price Relative Database (S.P.P.R.)* from the Centre for Research in Finance at the Australian Graduate School of Management. The database provides the monthly returns on all Australian listed stocks used in this study, as well as market capitalisation figures at the end of each month, used as a measure of firm size. The All Ordinaries Accumulation Index was used as the value-weighted stock index (yielding  $R_t^{VW}$ ),<sup>8</sup> and as this index begins in 1980,

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a full discussion of this matter. In contrast to Ross (1976), returns are not assumed to have a linear factor structure.

<sup>8</sup> On April 1 2000, the composition of the index was broadened to include 500 stocks, as opposed to 266 before this date. Analysis of the time series of monthly returns after this date, and also the

the sample period extends from 31 January 1980 to 31 December 2001.<sup>9</sup> Due to the need to estimate betas prior to portfolio formation, however, the test period begins on the 31 January 1982. We follow JW's portfolio formation methodology and construct forty-nine portfolios. First, seven size-based portfolios were formed. Each of these portfolios was then sorted into seven further portfolios based on their companies' equity market betas.<sup>10</sup> We adopted this "septile" approach because forming portfolios based on deciles, as JW did, is impractical in our study given the smaller number of stocks listed in the Australian market.<sup>11</sup> The number of equities available for inclusion in the portfolios, whose returns form our dependent variable, at each portfolio formation date, may be found in Table 1.

[TABLE 1 ABOUT HERE]

Obtaining measures of the second and third exogenous variables,  $\beta^{labour}$  and  $\beta^{rem}$ , is problematic outside the US. Monthly macroeconomic data is not available in Australia so we relied on quarterly data. This resulted in a time series of 80 return observations for each of the 49 portfolios. Our data for the return on human capital, used to calculate  $\beta^{labour}$ , is from the "Average Weekly Earnings of Employees: Dollars: Seasonally Adjusted" time-series available from the Australian Bureau of Statistics, and, following JW, a two-month moving average was used to smooth the series. The spread between long-term AAA and BAA-rated

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relationship of the index to the American index (see sub-section 5.3 below) provides no evidence of a statistically significant variation in the index which might flow through to this study.

<sup>9</sup> Whether to include the final quarter of 1987 given the substantial market crash in October is a moot point: inclusion of observations from this time period does not materially affect the conclusions we draw from our analysis.

<sup>10</sup> Based on a minimum of two years (and maximum of five years) of monthly data prior to portfolio formation.

commercial bonds is well supported as a forward indicator of economic conditions in the US.<sup>12</sup> In Australia, the illiquidity of the domestic bond market means that data on investment grade bonds is available only from 1997 on, and data on speculative bonds is non-existent. Given Australia's integration with the global economy, and evidence that there is a strong link with US markets,<sup>13</sup> we believe expectations for the US economy should also act as a leading indicator for Australian conditions. Consequently, we utilize the Fisher effect by means of the following equation

$$r_{AU} = \left[ \frac{(1 + i_{AU})(1 + r_{US})}{1 + i_{US}} \right] - 1 = R_{t-1}^{prem}, \quad (2)$$

where  $r_{AU}$  and  $r_{US}$  refer to the 10-year government bond yields at the end of period  $t - 1$ , while  $i_{AU}$  and  $i_{US}$  denote the realized inflation rates in period  $t$ . The analysis reported in this paper indicates that this variable seems to function for Australian returns much as the spread functions in the US market.<sup>14</sup> Having found  $\beta_i^{prem}$  for portfolio  $i$ ,  $i = 1, 2, \dots, 49$ , by regressing portfolio returns on  $R_{t-1}^{prem}$ ,  $\beta_i^{prem}$  is then modified to retain only the proportion of the estimate that is orthogonal to  $\beta_i^{VW}$ . This is done by regressing  $\beta_i^{prem}$  on  $\beta_i^{VW}$ , and taking the regression residuals as the new measure of  $\beta_i^{prem}$ . A similar calculation is performed for the labour beta. In this case, however, the modified value is orthogonal to both  $\beta_i^{VW}$  and  $\beta_i^{prem}$ :

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<sup>11</sup> We also analyzed the data forming portfolios on the basis of quartiles (with 16 portfolios in total) and quintiles (yielding 25 portfolios). Our results are robust to the formation of fewer, though more densely populated, portfolios.

<sup>12</sup> See JW (p. 11) for relevant US literature.

<sup>13</sup> See Raganathan, Faff and Brooks (1999), Durand, Koh and Watson (2001) and Section 5.3 below.

<sup>14</sup> Further tests of this proxy would be a useful course for future research. The 10-year government bond rates and CPI levels in the US are obtained from the Federal Reserve website

Each equation is estimated using both OLS and GMM specifications. In our OLS calculations, we follow JW in adjusting  $t$ -statistics for sampling error inherent in the estimated betas.<sup>15</sup> In our GMM analyses, we follow JW in using the weighting matrix,  $A = \left(E[R_t R_t^T]\right)^{-1}$ , for testing various restricted models, as it remains constant across competing models, and allows direct comparison of the pricing errors across each specification by means of the Hansen-Jagannathan ( $HJ$ ) distance (Hansen & Jagannathan, 1994, 1997).<sup>16</sup> In a departure from JW, we utilize a bootstrapping procedure, based on 10,000 samples, to derive the empirical distribution of the  $HJ$ -distance statistic.<sup>17</sup> The bootstrapping technique is used to construct not only a sample distribution for the  $HJ$ -distance, but also a unique sampling distribution for each of the  $\delta$  estimates appearing in each equation estimated using GMM.

#### 4.0 Tests of the Conditional CAPM and the CAPM

Table 2 reports summary statistics for the data used in the analysis.<sup>18</sup> Perhaps the most striking aspect relates to market capitalization. The data shows that, by way of contrast to the US, the size-effect in Australia is very large indeed.<sup>19</sup>

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(<http://www.federalreserve.gov>), and CPI levels in Australia are provided by the Australian Bureau of Statistics (ABS) website (<http://www.abs.gov.au>).

<sup>15</sup> The technique is discussed in detail in Appendix B of JW.

<sup>16</sup> See JW, pages 16 to 18 for a detailed discussion.

<sup>17</sup> In this analysis, the bootstrap provided a tractable alternative to the analytic solution provided in JW's Appendix C. It is well known that the bootstrap results in a consistent estimate for the distribution of the test statistic. See, for example, Shao and Tu (1995) for a detailed discussion (especially Chapter 3).

<sup>18</sup> Additional summary statistics may be downloaded from the corresponding author's website.

[TABLE 2 ABOUT HERE]

Tests of the CAPM, the CCAPM and the CCAPM including the return on human capital are reported in Table 3.<sup>20</sup> We express  $p$ -values as percentages in order to be consistent with JW's approach to presenting results. The OLS tests of the CAPM (Panel A) are consistent with the US versions: the evidence that beta is priced is, at best, marginal (the corrected  $t$ -statistic has a  $p$ -value of 7.19%) and the value of  $R^2$  is relatively low (7.25%). In contrast to JW, the  $t$ -statistics for the coefficients (corrected for sampling errors in the  $\beta$ s from the Fama-MacBeth estimation) result in a marked difference in the interpretation of our results: there appears to be more noise in our data set.<sup>21</sup>

Panels B and C of Table 3 present the results for the CCAPM. OLS analyses of the PL model without (Panel B), and with (Panel C), returns to human capital, do not "save" the market beta; the corrected  $t$ -statistics indicate that, in no instance, can the null hypothesis that  $c_{VW}$  equals zero be rejected. In Panels B and C, we see that  $c_{labour}$  is not significant. Rather, it is  $c_{prem}$  that is found to have a negative and statistically significant relationship to the cross-section of returns in Panels B and C. The negative relationship is perhaps surprising but consistent with the consumption smoothing approach in Breeden (1979).<sup>22</sup> Overall,

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<sup>19</sup> Such high returns should not be surprising to researchers familiar with recent Australian evidence. Gaunt, Gray and McIvor (2000, page 40, Table 2) find average monthly returns as high as 11.26% per month for portfolios of small stocks.

<sup>20</sup> We also tested the CAPM with human capital but the results, which may be downloaded from the corresponding author's website, do not materially affect our analysis.

<sup>21</sup> We do not report uncorrected  $t$ -statistics and their  $p$ -values in subsequent tables. In all analyses we subsequently report, correcting the bias in the estimated  $t$ -statistics has a material effect on the conclusions that may be drawn from the analysis. The uncorrected values appear redundant.

<sup>22</sup> Consumption CAPM's have not been extensively studied in Australia. Faff (1998) finds evidence for significant consumption betas using quarterly data, but utilizing monthly data, and a maximum correlation portfolio methodology, the results were inconclusive. Durand (1999), however, found no support for the inverse relationship of consumption to returns hypothesized by such models.

using the value of  $R^2$  as a guide, the CCAPMs reported in Panels B and C provide a better explanation of the cross section of returns than the CAPM.<sup>23</sup>

In contrast to JW, who found that the value of the PL intercept in their data was too high to be consistent with a correctly specified model of returns, the estimate of 1.02 (equivalent to 8% *per annum*) reported in this paper is in keeping with the average risk-free rate over the period, which was 9.52% *per annum* (the standard deviation of the average risk-free rate is estimated to be 4.3%). All the intercepts calculated in the OLS regressions we report (Tables 3 to 6) are consistent with this analysis.

Despite the success of the OLS analyses, none of the GMM analyses reported in Table 3 provides support for the hypothesis that the factors we study function as the stochastic discount factor. In each case, the estimated coefficients for  $\delta$  are not significantly different from zero. The measures of the *HJ*-distance indicate that the pricing errors are significantly different from zero. In contrast to the OLS test, the GMM approach tests strict arbitrage-free equilibrium conditions. Clearly, none of the models we study conforms to these strict conditions. Thus, while our OLS analyses suggest that our models provide a good explanation for the cross-section of returns, we cannot conclude that these relationships are consistent with a no-arbitrage equilibrium determining the cross-section of returns.

In view of the *prima facie* evidence for the importance of size, we augment each of the OLS analyses in Table 3 with  $ME_i$  - the market value of firm  $i$ 's outstanding equity (in millions of

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<sup>23</sup> Like JW, we produce plots of the models reported in Table 3 to illustrate the goodness of fit. These plots may be obtained from the corresponding author's website.

dollars). If the models are to be good descriptions of the cross-section of returns, the estimate of  $c_{size}$  should be insignificantly different from zero. Panel A shows that  $c_{size}$  is negative and significant when augmenting the CAPM. In both specifications of the PL model (Panels B and C), the null hypothesis that  $ME_i$  does not influence the cross-section of returns cannot be rejected.

## **5.0 Does the Conditional CAPM outperform competing asset pricing models?**

### **5.1 Comparison with factors used by Fama and French (1993)**

To test Fama and French's (1993) three-factor model, time series returns are required for the small-minus-big (*SMB*) and high-minus-low (*HML*) factors. The *SMB* factor is constructed with stock returns from SIRCA's Core Research Database, and market capitalisation figures from the AGSM's S.P.P.R Database. The sample of stocks is then ranked according to market capitalisation, with the *SMB* measure defined as the discrete monthly return to a value-weighted portfolio of the smallest 30% of stocks, minus the discrete monthly return to a value-weighted portfolio of the largest 30% of stocks.<sup>24</sup> These portfolios are rebalanced each month, on the last trading day before the beginning of the successive month. The *HML* measure is constructed in a similar manner, from a similar dataset. Stocks are ranked according to each firm's ratio of book equity to market equity, with book value data (specifically, the book value of shareholders' equity less deferred taxes and the book value of deferred stock) provided by the Company Analysis Database from Datastream (and market

equity values obtained from the S.P.P.R database). As with the *SMB* measure, the portfolios used to calculate *HML* are rebalanced monthly.<sup>25</sup> Both *SMB* and *HML* cover the period March 1990 to December 2001 (as reliable data does not extend as far back as 1982, which marks the commencement of the sample for all other tests).<sup>26</sup>

[TABLE 4 ABOUT HERE]

The results of the analysis are reported in Table 4. In keeping with JW, we first report the results for the 3-factor model and then add the PL factors to the three-factor model. The insignificant coefficients and significant pricing errors estimated using GMM, are consistent with the results reported in Table 3. Therefore, the remaining discussion focuses on the OLS estimates. In both the OLS regressions, the estimated value for the intercept is statistically significant and consistent with our findings in Table 3.

In the analysis of the three-factor model, the hypothesis that the estimated coefficients for the market and HML betas are equal to zero cannot be rejected.  $c_{SMB}$  is positive and statistically significant. Thus, our findings are consistent with those of Halliwell *et al.* (1999) and inconsistent with those of Faff (2001), although the time period we examine is coincident with the period examined by Faff rather than the period examined by Halliwell *et*

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<sup>24</sup> Although this differs from the 50/50 split adopted in Fama and French (1993, pp. 8-9), the grouping we have adopted is common in the literature (see, for example, Halliwell *et al.*, 1999) and is arguably more appropriate when comparing against the value-growth grouping.

<sup>25</sup> In contrast to Fama and French (1993, p. 8) we adopt this more active approach to facilitate comparison with SMB. To reduce the influence of any “look-ahead” bias, when we rank stocks at month  $t$  we use book values at time  $t-1$ .

<sup>26</sup> SMB was found to have a monthly average price relative of 1.0412 and HML 1.0097. The correlation between SMB and HML was 0.42. Further summary statistics on these variables has been included with the analysis that may be downloaded from the corresponding author’s website.

*al.* It may be that the discrepancy is a result of differences in factor construction: Faff, as noted in Section 2, proxies HML (and SMB) through commercially available factors. The sensitivity of such analyses to the construction of HML is clearly a useful area for future research. The adjusted  $t$ -statistics indicate that SMB remains significant when the additional two variables,  $\beta^{prem}$  and  $\beta^{labour}$ , are added. In this case, rather than  $c_{prem}, c_{labour}$  is positive and statistically significant although the effect is small.

Table 4 provides no support for the 3-factor model *per se*, but given the significance of  $c_{SMB}$  and the values of  $R^2$  for both equations, there is strong support for the role of SMB as a determinant of the cross-section of returns. Using the value of  $R^2$  as a guide, the three-factor model outperforms the PL model. The inclusion of  $c_{labour}$  is found to be statistically significant in the second OLS regression and there is an increase in the value of  $R^2$ , indicating that a combination of the three-factor model and the PL model supplies useful incremental explanatory power in explaining the cross-section of returns.

## 5.2 Comparison with Arbitrage Pricing Theory factors

As with the early CAPM studies, development of the APT in Australia has followed a similar path to the research in the United States. Early work in Australia utilised data reduction techniques to determine the number of priced factors (Sinclair, 1984; Faff, 1988, 1992). Later, Groenewold & Fraser (1997) followed an approach similar to Chen, Roll, & Ross (1986) through an investigation of whether pre-specified variables were priced.

Results comparing the PL model with Chen *et al.*'s factors are reported in Table 5.<sup>27</sup> The OLS intercept values and findings for the GMM analysis are consistent with previously reported analyses. Hence, we again focus on the results of the OLS analyses.<sup>28</sup>

[TABLE 5 ABOUT HERE]

This is little evidence that the Chen *et al.* factors are priced in Australia as they are in the US. Table 5 indicates that only the GDP beta exhibits a significant coefficient (at the 0.76% level after correcting for beta sampling errors). The model  $R^2$  is lower than that reported for the PL models in Table 3. The addition of the premium and labour betas increases the  $p$ -value of  $c_{GDP}$  to 5.98% and the model  $R^2$  increases to 78.15%. Once again there is a significant negative loading on  $\beta_i^{prem}$ . The negative coefficients for both  $c_{GDP}$  and  $c_{prem}$  are consistent with the consumption-smoothing hypothesis discussed in Section 4.

### 5.3 Is the United States a priced factor?

There is evidence that movements in the US markets influence returns in other markets around the world.<sup>29</sup> Raganathan, Faff and Brooks (1999) found that Australian and US returns are related, but that the relationship is sensitive to the stage of the business cycle.

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<sup>27</sup> An analysis comparing the PL model with Groenewold and Fraser's factors may be downloaded from the corresponding author's website. We find that the PL model is superior to Groenewold and Fraser's realization of the APT.

<sup>28</sup> Australian inflation rates are calculated from the CPI time-series provided by the ABS (the same time-series used in the calculation of  $R_i^{prem}$ ), 10-year government bonds and 13-week Treasury Bills are obtained from the Reserve Bank of Australia (RBA) website (<http://www.rba.gov.au>), and seasonally-adjusted GDP figures are available from the Australian Bureau of Statistics.

<sup>29</sup> See, for example, Eun & Shim (1989), Theodossiou & Lee (1993), Phylaktis (1997), and Ghosh, Saidi & Johnson (1999).

Durand et al. (2001) found that variations in the US market explain over 20% of the daily variance of the Australian market and that Australian returns are Granger-caused by movements in the US market. Durand and Scott (2003) suggest that the relationship of the Australian to the US market may be consistent with investors overreacting to US market movements. Given these findings, we examine the influence of US market movements over the cross-section of returns in Australia. Table 6 reports the analysis, including both US value-weighted index movements and the US/Australian exchange rate in the cross-sectional regression.<sup>30,31</sup> The OLS intercepts and findings for the GMM analysis are consistent with previously reported analyses.

[TABLE 6 ABOUT HERE]

The results reported in Table 6 show that only the exchange rate is significant when added to the CAPM. When premium and labour betas are added, the exchange rate effect disappears. As might be expected, the explanatory variables are highly correlated: the correlation between  $R_t^{VW}$  and  $R_t^{VW-US}$  is 0.60. The correlation between  $\beta_i^{VW}$  and  $\beta_i^{VW-US}$  is 0.93. Given that the Australian market beta is found to have no role in explaining the cross-section of returns, the finding that the strongly related US beta also has no role in explaining the cross-section of returns should not be surprising.

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<sup>30</sup> Loudon (1993) and Di Iorio and Faff (2002) provide evidence that the exchange rate has had a statistically significant relationship to Australian equity returns.

<sup>31</sup> A second analysis includes only the value-weighted index of US stocks, but the measure is expressed in Australian dollars. The findings are consistent with those reported in this paper. The analysis may be downloaded from the corresponding author's website.

#### 5.4 The cross-section of excess returns

A final test conducted by JW was to determine how well the PL model accords with an important outcome of the Black version of the CCAPM, which predicts an intercept term equal to the return on a zero-beta portfolio (or equal to the risk free rate  $r_f$  if borrowing and lending is available at such a rate). This zero-beta portfolio return should lie somewhere between riskless lending and borrowing rates. Hence a test is conducted to determine whether the empirically derived intercept term lies between what could plausibly be a riskless lending and borrowing rate.

[TABLE 7 ABOUT HERE]

The results of the analysis are reported in Table 7. The intercept term is statistically insignificantly different from zero in the OLS estimate of the PL model. Not only does this test suggest that the zero-beta and risk-free rates are similar, but that one is not statistically distinguishable from the other. In the OLS estimation using the Fama-French factors, the null hypothesis that the intercept equals zero can be rejected at a significance level of 5.44% and the results for  $\epsilon_{SMB}$  are also in keeping with those reported in Table 4. The marginal evidence of significance of a negative intercept suggests that the risk-free rate of return may be slightly higher than the zero beta return.

The results for the GMM estimates for both models provide a clear contrast to the analyses reported in Tables 3 to 6. The models are clearly sensitive to using excess returns rather than raw returns and, in these cases, the strict no-arbitrage restrictions are satisfied by both

formulations to within the accuracy of the sample estimation. In both the PL and the 3-factor estimates, pricing errors are insignificantly different from zero, although the PL model is to be preferred with a *HJ*-distance of 0.01 (compared to a *HJ*-distance of 0.05 for the Fama-French model). The null hypothesis that the coefficients for the three estimated values of delta equal zero can be rejected with confidence for the PL model. In the Fama-French formulation, the estimate of  $\delta_{HML}$  is also significantly different from zero but the hypothesis that  $\delta_{SMB}$  equals zero cannot be rejected. Such findings are seemingly at odds with those reported for the Fama/French model in Table 4 and suggest that further research into the role of HML is warranted with Australian data.

By using excess returns, the variation in the risk-free rate through time is implicitly incorporated into the specification, as the returns at each time period are calculated using the corresponding risk-free rate for each particular time period. Hence, the GMM acceptance of the stochastic discount factor for excess returns, and rejection of the stochastic discount factor for gross returns, could well be a reflection of the non-stationarity in parameters. When the risk-free rate is permitted to vary through time, the strict no-arbitrage equilibrium of the GMM is satisfied by the data, but when the non-stationary parameters are forced to assume a constant value (through the tests in all tables other than Table 7) the equilibrium relation is rejected.

## 6.0 Conclusion

JW (Jagannathan & Wang, 1996) develop and test a Conditional CAPM (CCAPM) that makes specific allowance for the fact that portfolios' betas may vary systematically. Their empirical examination of the model using US data is supportive of this hypothesis. We have followed JW, with some relatively minor modifications and extensions, in testing the Premium-Labour (PL) formulation of the CCAPM with Australian data. Our OLS analyses provide evidence that the PL model successfully describes the cross-section of returns, although it is clear that it may be improved upon by adding other variables that have been shown to have explanatory power. Our GMM analyses find the model to be inconsistent with the strict arbitrage-free conditions required by a stochastic discount model of returns when the risk-free rate is assumed to be constant. In our analysis of excess returns (Section 5.4), however, both the PL model and the three-factor model are consistent with stochastic-discount explanations for returns.

In contrast to JW's analysis of US data, we do not "save" the market beta through the inclusion of a proxy for the returns to human capital. When it does achieve significance in our analysis of the PL model, the human capital effect is negative rather than positive, suggesting that it functions as a state variable for current consumption as postulated by Breeden (1979) rather than as a market risk premium (in this latter case we would expect the effect to be positive). This variable is sensitive to the inclusion of other explanatory variables: its significance disappears when we add  $\beta^{rem}$  to the analysis. It is  $\beta^{rem}$ , derived from the US long-term interest rate adjusted for inflation differentials between the two

countries, that drives the explanatory power of the model in almost all the situations we study.

Using the value of  $R^2$  as a guide, we find that the PL model outperforms the APT, although it slightly underperforms the 3-factor model. The latter finding is driven by the significance of SMB: we do not find a role for HML, although our analysis of zero-beta formulations suggests that the role of this factor requires further research for its full explication. When comparing the PL and 3-factor models, JW argue that SMB and HML proxy for the multiple sources of market risk overtly specified in the PL model. The evidence in the present paper points to a role for SMB in an augmented PL model. It appears that more influence can be ascribed to SMB than as just acting as a proxy for mispriced market risk. We depart from JW's analysis in that we also consider a role for the US market in determining the cross-section of returns. We find that the PL model outperforms our US-market variables although, given the strong role of  $\beta^{\text{prem}}$ , we suggest that future research is required to address whether the Australian market is merely a vassal of the dominant American market.

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Table 1

<b>Portfolio formation year (31 December)</b>	<b>Stocks available for Portfolio Formation</b>	<b>Portfolio formation year (31 December)</b>	<b>Stocks available for Portfolio Formation</b>
1981	415	1991	642
1982	525	1992	619
1983	590	1993	651
1984	589	1994	651
1985	630	1995	718
1986	655	1996	783
1987	749	1997	762
1988	762	1998	764
1989	818	1999	795
1990	658	2000	792

**Sample size at each portfolio formation date**

Table 2

*Basic Characteristics of the 49 Portfolios*

Using publicly listed, non-financial Australian firms, the 49 portfolios are formed in a similar manner to Fama & French (1992). For every calendar year, starting from 1982, firms are first sorted into size septiles based on their market value at the end of December. For each size category, each firm's pre-beta is estimated by the slope coefficient in the regression of the 24 to 60 months of past-return data on a constant and the All Ordinaries Accumulation Index of the corresponding months. Firms within each size septile are then sorted into beta septiles based on their pre-betas. This gives 49 portfolios, and the return on each of these portfolios for the next 12 calendar months is computed by equally weighting the returns on stocks in the portfolio. This procedure is repeated for each calendar year. This gives a time series of monthly returns, which is then converted to quarterly returns, as the inflation data used in the calculation of  $R_t^{prem}$  is only available quarterly. The time-series extends from March 1982 to December 2001, i.e., 80 observations.  $\beta_i^{VW}$  is the slope in the regression of portfolio  $i$ 's return on the All Ordinaries Accumulation Index and a constant for the entire 80-quarter period. A portfolio size is calculated as the equally-weighted average of the logarithm of the market value (in millions of Australian dollars) of the stocks in the portfolio.  $\beta_i^{prem}$  and  $\beta_i^{labour}$  are calculated in a similar way. The numbers given in Panel D are that part of  $\beta_i^{prem}$  which is orthogonal to a constant and  $\beta_i^{VW}$ , and the numbers in Panel E are that part of  $\beta_i^{labour}$  which is orthogonal to a constant, to  $\beta_i^{VW}$  and to  $\beta_i^{prem}$ .

	$\beta$ - L	$\beta$ - 2	$\beta$ - 3	$\beta$ - 4	$\beta$ - 5	$\beta$ - 6	$\beta$ - H
Panel A: Time-Series Averages of Returns							
Size - S	16.38	14.57	20.22	20.67	24.21	19.41	22.43
Size - 2	8.27	8.93	9.30	9.46	8.87	9.69	8.52
Size - 3	1.83	4.99	5.73	4.30	4.72	5.63	5.12
Size - 4	4.48	5.25	3.25	2.60	4.29	1.03	-0.17
Size - 5	3.79	3.56	3.18	2.92	1.68	3.71	1.79
Size - 6	3.27	3.41	2.99	3.38	3.68	1.29	0.29
Size - B	4.04	5.70	4.07	3.61	1.99	2.07	1.06
Panel B: The Estimated $\beta_i^{VW}$ s							
Size - S	-0.03	0.86	1.36	1.10	1.67	1.48	1.56
Size - 2	0.69	0.53	1.19	1.15	1.42	1.41	1.11
Size - 3	0.50	0.76	0.61	1.00	1.18	1.34	1.57
Size - 4	0.51	0.74	0.74	0.71	1.00	1.10	1.23
Size - 5	0.48	0.58	0.72	0.86	0.96	1.31	1.12
Size - 6	0.68	0.61	0.73	0.90	1.04	1.31	1.43
Size - B	0.89	0.89	0.88	0.96	1.11	1.04	1.24

Panel C: The Time-Series Averages of Size (log AUD million)							
Size - S	2.25	2.26	2.32	2.32	2.33	2.35	2.35
Size - 2	2.65	2.66	2.67	2.63	2.64	2.65	2.65
Size - 3	2.89	2.92	2.93	2.91	2.90	2.91	2.89
Size - 4	3.19	3.21	3.19	3.18	3.18	3.17	3.16
Size - 5	3.53	3.54	3.54	3.54	3.51	3.54	3.50
Size - 6	3.93	3.99	3.98	4.02	4.03	4.01	3.98
Size - B	4.80	4.84	4.90	4.90	4.91	4.99	4.79
Panel D: The Estimated $\beta_i^{prem}$ that is Orthogonal to $\beta_i^{VW}$							
Size - S	-3.13	-1.67	-1.86	-4.37	-1.75	-4.23	-3.77
Size - 2	-1.98	-3.86	0.90	0.30	1.88	-0.39	-0.03
Size - 3	0.19	-0.79	-0.29	-0.16	1.37	-0.32	1.53
Size - 4	-0.67	1.14	1.24	1.05	0.84	-0.10	0.84
Size - 5	0.96	0.71	0.42	-0.58	1.04	0.74	0.06
Size - 6	0.93	0.57	1.41	0.46	0.62	0.08	1.76
Size - B	1.53	1.83	1.55	0.98	1.22	1.52	0.25
Panel E: The Estimated $\beta_i^{labour}$ that is Orthogonal to $\beta_i^{prem}$ and $\beta_i^{VW}$							
Size - S	-1.43	-3.24	-2.38	4.05	1.03	-0.48	0.28
Size - 2	-1.40	0.24	-1.09	-3.49	-2.57	-0.27	0.62
Size - 3	0.32	-0.18	0.92	-1.00	-1.02	-3.61	0.16
Size - 4	0.00	-0.93	-0.45	-0.63	-0.18	-0.20	-0.04
Size - 5	-0.04	1.19	-0.21	0.84	-0.62	0.33	2.16
Size - 6	-0.06	0.85	0.74	1.49	0.73	1.20	1.41
Size - B	1.58	-0.11	0.78	0.71	0.94	0.18	2.91

Table 3

*Evaluation of Various CAPM Specifications*

This table gives the estimates for the cross-sectional regression model

$$E[R_{it}] = c_0 + c_{size} \log(ME_i) + c_{VW} \beta_i^{VW} + c_{prem} \beta_i^{prem} + c_{labour} \beta_i^{labour}$$

and for the model for the moments

$$E[R_{it} (\delta_0 + \delta_{VW} R_t^{VW} + \delta_{prem} R_{t-1}^{prem} + \delta_{labour} R_t^{labour})] = 1$$

with either a subset or all of the variables. Here,  $R_{it}$  is the price relative ( $P_t/P_{t-1}$ ) for portfolio  $i$  ( $i = 1, 2, \dots, 49$ ) in quarter  $t$  (March 1982-December 2001),  $R_t^{VW}$  is the return on the value-weighted index of stocks,  $R_{t-1}^{prem}$  is the expected 10-year government bond yield in Australia based on US yields and inflation differentials between the two countries, and  $R_t^{labour}$  is the growth rate in per capita labour income.  $\beta_i^{VW}$  is the slope coefficient in the OLS regression of  $R_{it}$  on a constant and  $R_t^{VW}$ . The other betas are estimated in a similar way. The portfolio size,  $\log(ME_i)$ , is calculated as the equally-weighted average of the logarithm of the market value (in million dollars) of the stocks in portfolio  $i$ . The regression models are estimated using the Fama-MacBeth procedure. The “corrected  $t$ - and  $p$ -values” take sampling errors in the estimated betas into account. The models for the moments are estimated using the Generalised Method of Moments with the Hansen-Jagannathan weighting matrix. The minimized value of the GMM criterion function is the first item under the “HJ-dist”, with the associated  $p$ -value immediately below it. All the R-squares and  $p$ -values are reported as percentages, with all GMM  $p$ -values derived from a bootstrapping procedure.

Panel A: The Static CAPM without Human Capital						
Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{size}$	R-square
Estimate:	1.02	0.05				7.25
$t$ -value:	79.19	2.01				
$p$ -value:	0.00	4.99				
Corrected- $t$ :	70.85	1.84				
Corrected- $p$ :	0.00	7.19				
Estimate:	1.19	0.04			-0.05	45.85
$t$ -value:	34.42	1.63			-4.44	
$p$ -value:	0.00	10.92			0.01	
Corrected- $t$ :	32.25	1.56			-4.16	
Corrected- $p$ :	0.00	12.66			0.01	
Coefficient:	$\delta_0$	$\delta_{VW}$	$\delta_{prem}$	$\delta_{labour}$		HJ-dist
Estimate:	-3.21	3.99				1.89
$p$ -value:	65.74	50.20				0.20

Panel B: The Conditional CAPM without Human Capital						
Coefficient:	$\epsilon_0$	$\epsilon_{VW}$	$\epsilon_{prem}$	$\epsilon_{labour}$	$\epsilon_{size}$	R-square
Estimate:	1.02	0.05	-0.03			65.31
<i>t</i> -value:	79.19	2.01	-5.64			
<i>p</i> -value:	0.00	5.01	0.00			
Corrected- <i>t</i> :	33.90	0.87	-2.51			
Corrected- <i>p</i> :	0.00	38.92	1.57			
Estimate:	1.08	0.04	-0.02		-0.02	68.59
<i>t</i> -value:	41.07	1.93	-6.66		-2.26	
<i>p</i> -value:	0.00	6.03	0.00		2.87	
Corrected- <i>t</i> :	20.61	0.98	-3.62		-1.14	
Corrected- <i>p</i> :	0.00	33.12	0.07		26.23	
Coefficient:	$\delta_0$	$\delta_{VW}$	$\delta_{prem}$	$\delta_{labour}$		HJ-dist
Estimate:	-4.23	3.70	55.90			1.79
<i>p</i> -value:	64.90	48.96	48.59			0.55
Panel C: The Conditional CAPM with Human Capital						
Coefficient:	$\epsilon_0$	$\epsilon_{VW}$	$\epsilon_{prem}$	$\epsilon_{labour}$	$\epsilon_{size}$	R-square
Estimate:	1.02	0.05	-0.03	-0.01		68.56
<i>t</i> -value:	79.19	2.01	-5.64	-2.62		
<i>p</i> -value:	0.00	5.02	0.00	1.20		
Corrected- <i>t</i> :	27.47	0.71	-2.03	-0.92		
Corrected- <i>p</i> :	0.00	48.44	4.83	36.04		
Estimate:	1.06	0.04	-0.02	0.00	-0.01	69.45
<i>t</i> -value:	43.97	2.01	-7.12	-1.84	-1.45	
<i>p</i> -value:	0.00	5.04	0.00	7.24	15.36	
Corrected- <i>t</i> :	18.02	0.84	-3.16	-0.77	-0.60	
Corrected- <i>p</i> :	0.00	40.73	0.29	44.33	55.40	
Coefficient:	$\delta_0$	$\delta_{VW}$	$\delta_{prem}$	$\delta_{labour}$		HJ-dist
Estimate:	-8.55	3.79	54.03	4.22		1.79
<i>p</i> -value:	47.76	49.20	50.34	46.27		0.33

Table 4

**Comparison with the Factors used by Fama and French (1993)**

This table gives the estimates for the cross-sectional regression model:

$$E[R_{it}] = c_0 + c_{VW} \beta_i^{VW} + c_{prem} \beta_i^{prem} + c_{labour} \beta_i^{labour} + c_{SMB} \beta_i^{SMB} + c_{HML} \beta_i^{HML}$$

and for the model for the moments

$$E[R_{it} (\delta_0 + \delta_{VW} R_t^{VW} + \delta_{prem} R_{t-1}^{prem} + \delta_{labour} R_t^{labour} + \delta_{SMB} SMB_t + \delta_{HML} HML_t)] = 1$$

with either a subset or all of the variables. Here,  $R_{it}$  is the price relative ( $P_t/P_{t-1}$ ) for portfolio  $i$  ( $i = 1, 2, \dots, 49$ ) in quarter  $t$  (March 1990-December 2001),  $R_t^{VW}$  is the return on the All Ordinaries Accumulation Index,  $R_{t-1}^{prem}$  is the expected 10-year government bond yield in Australia based on US yields and inflation differentials between the two countries,  $R_t^{labour}$  is the growth rate in per capita labour income, and  $SMB_t$  and  $HML_t$  denote the respective Fama and French (1993) factors that are designed to capture the risks related to firm size and book-to-market equity.  $\beta_i^{VW}$  is the slope coefficient in the OLS regression of  $R_{it}$  on a constant and  $R_t^{VW}$ . The other betas are estimated in a similar way. The regression models are estimated using the Fama-MacBeth procedure. The “corrected  $t$ - and  $p$ -values” take sampling errors in the estimated betas into account. The models for the moments are estimated using the Generalised Method of Moments with the Hansen-Jagannathan weighting matrix. The minimized value of the GMM criterion function is the first item under the “HJ-dist”, with the associated  $p$ -value immediately below it. All the R-square and  $p$ -values are reported as percentages, with all GMM  $p$ -values derived from a bootstrapping procedure.

Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{SMB}$	$c_{HML}$	R-square
Estimate:	0.99	-0.01			0.13	0.01	71.70
Corrected- $t$ :	102.96	-1.05			4.43	0.62	
Corrected- $p$ :	0.00	30.09			0.01	53.68	
Coefficient:	$\delta_0^*$	$\delta_{VW}^*$	$\delta_{prem}^*$	$\delta_{labour}^*$	$\delta_{SMB}^*$	$\delta_{HML}^*$	HJ-dist*
Estimate:	6.80	5.80			-2.95	-8.19	2.11
$p$ -value:	24.96	53.19			8.36	40.10	0.00
Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{SMB}$	$c_{HML}$	R-square
Estimate:	0.99	-0.02	0.00	0.004	0.14	0.01	76.26
Corrected- $t$ :	79.84	-1.09	-0.55	2.38	3.19	0.37	
Corrected- $p$ :	0.00	28.12	58.75	2.18	0.27	71.04	
Coefficient:	$\delta_0^*$	$\delta_{VW}^*$	$\delta_{prem}^*$	$\delta_{labour}^*$	$\delta_{SMB}^*$	$\delta_{HML}^*$	HJ-dist*
Estimate:	57.99	5.23	42.82	-51.14	-3.36	-7.45	2.09
$p$ -value:	34.44	54.21	34.14	36.54	12.91	41.27	0.00

Table 5

**Comparison with the Factors used by Chen, Roll, and Ross (1986)**

This table gives the estimates for the cross-sectional regression model:

$$E[R_{it}] = c_0 + c_{VW} \beta_i^{VW} + c_{prem} \beta_i^{prem} + c_{labour} \beta_i^{labour} + c_{UTS} \beta_i^{UTS} + c_{GDP} \beta_i^{GDP} + c_{UI} \beta_i^{UI}$$

and for the model for the moments

$$E[R_{it} (\delta_0 + \delta_{VW} R_t^{VW} + \delta_{prem} R_{t-1}^{prem} + \delta_{labour} R_t^{labour} + \delta_{UTS} UTS_t + \delta_{GDP} GDP_t + \delta_{UI} UI_t)] = 1$$

with either a subset or all of the variables. Here,  $R_{it}$  is the price relative ( $P_t/P_{t-1}$ ) for portfolio  $i$  ( $i = 1, 2, \dots, 49$ ) in quarter  $t$  (March 1982-December 2001),  $R_t^{VW}$  is the return on the All Ordinaries Accumulation Index,  $R_{t-1}^{prem}$  is the expected 10-year government bond yield in Australia based on US yields and inflation differentials between the two countries,  $R_t^{labour}$  is the growth rate in per capita labour income,  $UTS_t$  is the return spread between long-term government bonds and Treasury bills,  $GDP_t$  is the growth rate in Australia's Gross Domestic Product, and  $UI_t$  is the change in inflation rate.  $\beta_i^{VW}$  is the slope coefficient in the OLS regression of  $R_{it}$  on a constant and  $R_t^{VW}$ . The other betas are estimated in a similar way. The regression models are estimated using the Fama-MacBeth procedure. The "corrected  $t$ - and  $p$ -values" take sampling errors in the estimated betas into account. The models for the moments are estimated using the Generalised Method of Moments with the Hansen-Jagannathan weighting matrix. The minimized value of the GMM criterion function is the first item under the "HJ-dist", with the associated  $p$ -value immediately below it. All the R-square and  $p$ -values are reported as percentages, with all GMM  $p$ -values derived from a bootstrapping procedure.

Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{UTS}$	$c_{GDP}$	$c_{UI}$	R-square
Estimate:	1.01	0.07			0.01	-0.01	0.00	38.41
Corrected- $t$ :	26.34	1.10			1.19	-2.80	-0.56	
Corrected- $p$ :	0.00	27.66			24.08	0.76	57.98	
Coefficient:	$\delta_0$	$\delta_{VW}$	$\delta_{prem}$	$\delta_{labour}$	$\delta_{UTS}$	$\delta_{GDP}$	$\delta_{UI}$	HJ-dist
Estimate:	-12.46	4.01			95.41	8.97	18.85	1.83
$p$ -value:	41.52	49.85			47.03	40.04	46.85	0.17
Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{UTS}$	$c_{GDP}$	$c_{UI}$	R-square
Estimate:	1.04	0.04	-0.03	-0.01	0.00	-0.01	0.00	78.15
Corrected- $t$ :	26.75	0.65	-2.44	-1.00	-0.69	-1.93	0.16	
Corrected- $p$ :	0.00	52.14	1.88	32.54	49.13	5.98	87.20	
Coefficient:	$\delta_0$	$\delta_{VW}$	$\delta_{prem}$	$\delta_{labour}$	$\delta_{UTS}$	$\delta_{GDP}$	$\delta_{UI}$	HJ-dist
Estimate:	-74.62	3.69	63.47	22.83	120.60	46.49	3.32	1.67
$p$ -value:	36.44	48.21	52.47	40.36	45.04	37.81	46.28	0.83

Table 6

### Is The United States A Priced Factor?

This table gives the estimates for the cross-sectional regression model

$$E[R_{it}] = c_0 + c_{VW} \beta_i^{VW} + c_{prem} \beta_i^{prem} + c_{labour} \beta_i^{labour} + c_{VW-US} \beta_i^{VW-US} + c_{USD/AUD} \beta_i^{USD/AUD}$$

and for the model for the moments

$$E\left[R_{it} \left( \delta_0 + \delta_{VW} R_t^{VW} + \delta_{prem} R_{t-1}^{prem} + \delta_{labour} R_t^{labour} + \delta_{VW-US} R_t^{VW-US} + \delta_{USD/AUD} e_t^{USD/AUD} \right)\right] = 1$$

with either a subset or all of the variables. Here,  $R_{it}$  is the price relative ( $P_t/P_{t-1}$ ) for portfolio  $i$  ( $i = 1, 2, \dots, 49$ ) in quarter  $t$  (March 1982-December 2001),  $R_t^{VW}$  is the return on the All Ordinaries Accumulation Index,  $R_{t-1}^{prem}$  is the expected 10-year government bond yield in Australia based on US yields and inflation differentials between the two countries,  $R_t^{labour}$  is the growth rate in per capita labour income,  $R_t^{VW-US}$  is the return on the S&P500 Composite Index in the US, and  $e_t^{USD/AUD}$  is the Australian/US exchange rate, expressed as a direct quote in Australia.  $\beta_i^{VW}$  is the slope coefficient in the OLS regression of  $R_{it}$  on a constant and  $R_t^{VW}$ . The other betas are estimated in a similar way. The regression models are estimated using the Fama-MacBeth procedure. The “corrected  $t$ - and  $p$ -values” take sampling errors in the estimated betas into account. The models for the moments are estimated using the Generalised Method of Moments with the Hansen-Jagannathan weighting matrix. The minimized value of the GMM criterion function is the first item under the “HJ-dist”, with the associated  $p$ -value immediately below it. All the R-square and  $p$ -values are reported as percentages, with all GMM  $p$ -values derived from a bootstrapping procedure.

Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{VW-US}$	$c_{USD/AUD}$	R-square
Estimate:	1.04	-0.05			0.11	0.61	26.30
Corrected- $t$ :	29.65	-0.76			1.60	2.25	
Corrected- $p$ :	0.00	45.35			11.63	2.91	
Coefficient:	$\delta_0$	$\delta_{VW}$	$\delta_{prem}$	$\delta_{labour}$	$\delta_{VW-US}$	$\delta_{USD/AUD}$	HJ-dist
Estimate:	1.64	6.30			-3.24	-2.81	1.83
$p$ -value:	49.83	57.12			61.60	62.12	0.30
Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{VW-US}$	$c_{USD/AUD}$	R-square
Estimate:	1.03	-0.02	-0.03	-0.01	0.10	0.26	73.78
Corrected- $t$ :	24.57	-0.29	-1.65	-0.71	1.27	1.21	
Corrected- $p$ :	0.00	77.57	10.54	48.44	21.20	23.37	
Coefficient:	$\delta_0$	$\delta_{VW}$	$\delta_{prem}$	$\delta_{labour}$	$\delta_{VW-US}$	$\delta_{USD/AUD}$	HJ-dist
Estimate:	11.34	5.64	51.79	-11.42	-3.39	-1.75	1.77
$p$ -value:	58.09	56.99	49.21	58.06	61.53	63.30	0.37

Table 7

**Tests Using the Time Series of Quarterly Excess Returns on the 49  
Size-Beta Sorted Portfolios**

This table gives the estimates for the following two regression models:

$$E[\tilde{R}_{it}] = c_{VW} \tilde{\beta}_i^{VW} + c_{prem} \tilde{\beta}_i^{prem} + c_{labour} \tilde{\beta}_i^{labour}$$

$$E[\tilde{R}_{it}] = c_{VW} \tilde{\beta}_i^{VW} + c_{SMB} \tilde{\beta}_i^{SMB} + c_{HML} \tilde{\beta}_i^{HML}$$

and for the two models for the moments

$$E\left[\tilde{R}_{it} \left(1 + \tilde{\delta}_{VW} R_t^{VW} + \tilde{\delta}_{prem} R_{t-1}^{prem} + \tilde{\delta}_{labour} R_t^{labour}\right)\right] = 0$$

$$E\left[\tilde{R}_{it} \left(1 + \tilde{\delta}_{VW} \tilde{R}_t^{VW} + \tilde{\delta}_{prem} R_{t-1}^{prem} + \tilde{\delta}_{labour} R_t^{labour}\right)\right] = 0$$

Here,  $\tilde{R}_{it} = R_{it} - R_t^{Tbill}$ , where  $R_{it}$  is the price relative ( $P_t/P_{t-1}$ ) on portfolio  $i$  ( $i = 1, 2, \dots, 49$ ) in quarter  $t$  (March 1982-December 2001 for the 1<sup>st</sup> model, and March 1990-December 2001 for the second) and  $R_t^{Tbill}$  is the return on the T-bill.  $R_t^{VW}$  is the return on the All Ordinaries Accumulation Index and  $\tilde{R}_t^{VW} = R_t^{VW} - R_t^{Tbill}$ .  $R_{t-1}^{prem}$  is the expected 10-year government bond yield in Australia based on US yields and inflation differentials between the two countries,  $R_t^{labour}$  is the growth rate in per capita labour income, and  $SMB_t$  and  $HML_t$  denote the respective Fama and French (1993) factors that are designed to capture the risks related to firm size and book-to-market equity.  $\tilde{\beta}_i^{VW}$  is the slope coefficient in the OLS regression of  $\tilde{R}_{it}$  on a constant and  $R_t^{VW}$ . The other  $\tilde{\beta}$ s are estimated in a similar way.  $\tilde{\beta}_i^{VW}$  is the slope coefficient in the OLS regression of  $\tilde{R}_{it}$  on a constant and  $\tilde{R}_t^{VW}$ . The regression models are estimated using the Fama-MacBeth procedure. The “corrected  $t$ - and  $p$ -values” take sampling errors in the estimated betas into account. The models for the moments are estimated using the Generalised Method of Moments with the Hansen-Jagannathan weighting matrix. The minimized value of the GMM criterion function is the first item under the “HJ-dist”, with the associated  $p$ -value immediately below it. All the R-square and  $p$ -values are reported as percentages, with all GMM  $p$ -values derived from a bootstrapping procedure.

Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{SMB}$	$c_{HML}$	R-square
Estimate:	-0.01	0.05	-0.03	-0.01			68.56
Corrected- $t$ :	-0.15	0.71	-2.03	-0.92			
Corrected- $p$ :	88.22	48.44	4.83	36.04			
Coefficient:		$\tilde{\delta}_{VW}$	$\tilde{\delta}_{prem}$	$\tilde{\delta}_{labour}$	$\tilde{\delta}_{SMB}$	$\tilde{\delta}_{HML}$	HJ-dist
Estimate:		-0.02	0.45	-0.98			0.01
$p$ -value:		0.69	0.00	0.00			30.14
Coefficient:	$c_0$	$c_{VW}$	$c_{prem}$	$c_{labour}$	$c_{SMB}$	$c_{HML}$	R-square
Estimate:	-0.02	-0.02			0.13	0.01	72.13
Corrected- $t$ :	-1.98	-1.37			4.43	0.54	
Corrected- $p$ :	5.44	17.80			0.01	58.93	
Coefficient:		$\tilde{\delta}_{VW}^*$	$\tilde{\delta}_{prem}^*$	$\tilde{\delta}_{labour}^*$	$\tilde{\delta}_{SMB}^*$	$\tilde{\delta}_{HML}^*$	HJ-dist
Estimate:		0.29			-0.07	-0.89	0.05
$p$ -value:		14.55			18.00	0.00	52.05