\documentclass{article}

\usepackage{amsmath}

\usepackage{amssymb}

\usepackage[top=2cm, bottom=4.5cm, left=2.5cm, right=2.5cm]{geometry}

\usepackage{graphicx}

\usepackage{float}

\title{\textbf{QF608 Research Methods for Quantitative Professionals}}

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\begin{document}

\maketitle

\section{Summary of Statistics}

\subsection{The explanatory variables}

The table below gives mean, standard deviation and test statistics for the three explanatory variables. The mean of market risk premium, 0.82\%, which implies 9.84\% on the annual basis, is much higher than what Fama and French reported (0.43\%) for their test period during 1963-1991. Both SMB and HML surprisingly turn negative with t-test suggests SMB is statistically significant from 0 with 95\% confidence level. In other words, small cap portfolios underperform large cap portfolios, high BE/ME portfolios no longer outperform low BE/ME portfolios. These are huge paradigm shift from Fama and French’s observation.

%\includegraphics[scale=0.6]{1.JPG}

\begin{figure}[H]

\centering

\caption{Table 1}

\includegraphics[width=0.5\linewidth]{1.JPG}

\end{figure}

\noindent The correlation matrix shows HML has little correlation with market risk premium and SMB. This implies HML brings in additional explanatory power that CAPM is not able to capture.

\begin{figure}[H]

\centering

\caption{Table 2}

\includegraphics[width=0.35\linewidth]{2.JPG}

\end{figure}

\subsection{The dependent variables}

Table below lists average of annual number of firms in each portfolio. 61.7\% of firms lie in the union of smallest cap quintile and lowest BE/ME quintiles (as highlighted).

\begin{figure}[H]

\centering

\caption{Table 3}

\includegraphics[width=0.5\linewidth]{3.JPG}

\end{figure}

\noindent Table 4 demonstrates average of monthly excess return for all 25 portfolios between 2011-2018. We are able to find a clear trend that excess returns get higher when size increase in each BE/ME quintiles. This finding aligns with the observation in Table 1. On the other hand, we can see lower BE/ME portfolios yields higher excess return in size quintiles “3” and “Big”, but the consistency does not hold for the other size quintiles. This inconsistency explains why the null hypothesis for HML in sections 1.1 was not rejected.

\begin{figure}[H]

\centering

\caption{Table 4}

\includegraphics[width=0.55\linewidth]{4.JPG}

\end{figure}

\section{Time-series Regression Results}

After performing linear regression for 25 portfolios between 2011-2018, coefficients for all regressors have been summarized in Table 5. First of all, for intercept a, we are unable to reject null hypothesis in 24/25 portfolios, except for the portfolio on the upper left corner as highlighted. This is to convey there is no abnormal return in FF-3 factor model, which implies its capability in explaining stock return variation. Secondly, t-test results for slope b suggest rejection of null hypothesis. As anticipated, values of slope b are close to 1. Thirdly, t-statistics are strong enough to reject null hypothesis for s (slope for SMB) in four smaller size quintiles. The exception happens for “Big” size quintiles where slopes turn negative as highlighted. Similarly, for HML, t-tests are not able to reject null hypothesis when h turns into positive from lower BE/ME quintile to higher BE/ME quintile.

\begin{figure}[H]

\centering

\caption{Table 5}

\includegraphics[width=1\linewidth]{5.JPG}

\end{figure}

\noindent In order to prove stronger explanatory power of FF-3 factor model, regression analysis has also been conducted on single factor CAPM. Results are tabulated below. Generally, t-statistics for intercept are much higher than they are in FF-3 in absolute term. This implies abnormal returns vanish with introduction of SMB and HML. On the other hand, b values for CAPM tend to be higher than when they are in FF-3. Last but not least, discrepancies of R2 in Table 5 and Table 6 indicate FF-3 factor model improves the explanatory power from 50\%-90\% range (CAPM) to 84\%-96\% range.

\begin{figure}[H]

\centering

\caption{Table 6}

\includegraphics[width=1\linewidth]{6.JPG}

\end{figure}

\section{Interpretation}

Fama and French explained size and BE/ME are not ad hoc variables for explaining average stock return(1992b). They believe both variables are related to economic fundamentals. Firms that have high BE/ME ratio tend to have low earnings on assets. The intuition is that investors would not be attracted by firms that have poor earning performance recently. Reversely, investors tend to invest in firms with strong earning/profitability figure recently (1992b). Size is also related to profitability. Fama and French attributed size effect to smalls firms not able to participate in economic boom of the middle and late 1980s., which pushed small firms to a long earnings depression. However, their paper in 1992b and 1993 did not explain how size and BE/ME’s relationship with earning leads to their relationship with average excess returns (of 25 portfolios).

Practitioners have been debating on whether the outperformance tendency is due to market efficiency or inefficiency. The “inefficiency” proponents believe the outperformance is explained by incorrectly value pricing of companies by market participants. However, the “mispricing view” does not explain why small firms were mispriced higher instead of lower between 1963-1991.

Given the paradigm shift mentioned in section 1.1 that small firms outperformed large firms between 2011-2018. We would like to vote for “efficiency”. Intuition comes as: in old days such as 1963-1991, it was not easy for investors to access to or liquidate small-cap stocks. In addition, small firms normally have higher cost of capital and greater business risk. All of these made small-cap stocks riskier to invest, hence higher return in old days. On the other hand, it is much easier for investors to access to small-cap stocks and liquidate nowadays. More transparent market also reduces risk of investing in small firms. These could explain why small cap stocks does not outperform large cap stocks as they used to be. However, more evidence needs to be found to support our intuition and more insight needs to be brought in in order to explain why small cap stocks underperform large cap stocks between 2011-2018.

\end{document}