

# The Role of Non-Marketable Assets to Determine the Cost of Capital: Evidence from India

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## ABSTRACT

**Manuscript type:** Research paper.

**Research aims:** This paper aims to examine the role of non-marketable assets namely, stock index, government bond index, human capital and real estate in a multi-asset proxy for the true market portfolio. It also examines the sensitivity of risk-return tradeoffs with different market portfolio compositions for both the conditional and unconditional versions of the asset pricing model.

**Design/ Methodology/ Approach:** This paper extends on Mayers' (1972) model by building a composite market portfolio which consists of stock, bond, human capital and real estate. The cross-section of asset returns is tested with Fama and Macbeth's (1973) regression method. The capital asset pricing model (CAPM) uses the Kalman filter based approach to estimate the conditional factor loadings.

**Research findings:** This study finds that when per unit of risk premium is equal, the market model standard beta over-estimates the systematic risk that is measured by the composite market portfolio. The effect of bond, human capital and real estate on the complete market portfolio does not have much impact on the empirical testing of the CAPM. However, the conditional model shows a significant and positive risk premium.

**Theoretical contributions/ Originality:** Despite the importance of the non-marketable assets, many studies have rarely integrated or validated these in an asset-pricing framework, within an emerging

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market. Thus, the present study seeks to advance the theoretical and empirical understanding of the role of non-marketable assets in the composition of market proxies for an asset pricing model, in India.

**Practitioner/ Policy implications:** The validity of the CAPM is insensitive to the inclusion of non-marketable assets in the market portfolio. This implies that investors use prior belief and conditioning variables as predictive variables to determine the cost of capital. The outcome of this study provides academics and practitioners a better understanding of the cross-sectional behaviour of stock returns in the Indian market.

**Research limitation:** The limited work done on the Indian capital market coupled by the limited availability of non-marketable data in this study, may constrain the comparison of the results. In addition, the outcome drawn from this study cannot be generalised on other emerging markets as the focus of this study was only on the Indian capital market.

**Keywords:** Fama-MacBeth Regression, Kalman Filter, Mayers CAPM, Non-marketable Assets.

**JEL Classification:** G12, G31

## 1. Introduction

In equilibrium, the Capital Asset Pricing Model (CAPM) satisfies two main predictions. The first says that the market portfolio is the mean-variance efficient portfolio while the second says that only the systematic risk or market beta of a stock is rewarded for higher expected returns. Based on these two predictions, empirical testing of the CAPM focuses on analysing the efficiency of the market portfolio and the risk-return relationship. However, since the true market portfolio cannot be directly observed in empirical tests, proxies are employed to describe the risk-return relationship. The results of such an investigation may lead to various interpretations. For instance, as a result of the mis-specification of the proxy, empirical testing of the implied risk-return relation may indicate a violation of the asset pricing theory. Thus, Roll (1977, p. 130) concludes that “the theory is not testable unless the exact composition of the true market portfolio is known and used in the tests”.

By definition, the market portfolio should consist of marketable and non-marketable assets. Marketable assets are those perfectly liquid assets and non-marketable assets are those perfectly illiquid assets where illiquidity is defined as the inability to freely trade an asset, based on portfolio choice (Mayers, 1973). For the purpose of diversifying their

investments, investors must decide on the type of asset portfolios to retain. Previous literature notes that marketable assets such as stocks form only a small part of the total wealth whereas non-marketable assets, including salaries, wages and real estates, constitute a significant component of the total wealth (Berger, Pukthuanthong, & Roll, 2016). This phenomenon suggests that non-marketable assets are important for the portfolio choice and the asset pricing theory. To replicate a bigger proportion of the economy's total wealth, Mayers (1972) developed a modified CAPM which incorporates both the marketable and non-marketable assets. Following this, other studies (Gómez, Priestley, & Zapatero, 2016; Mishra & O'Brien, 2016) also included other additional risk factors as a measure of the non-marketable assets into the multi-factor CAPM model. These studies recognise the importance of considering non-marketable assets returns when measuring systematic risk.

Despite the importance of the non-marketable assets, its inclusion into the market portfolio has rarely been integrated or validated in an asset pricing framework, particularly in an emerging market. It is not known whether the risk exposure of the portfolio changes when non-marketable assets are included. Moreover, most studies had only focused on stock and human capital in the composition of market portfolios. It appears that many of these studies had abstained from using a more realistic portfolio that consists of various marketable and non-marketable assets (Eiling, 2013; Jagannathan & Wang, 1996; Palacios, 2015). While there are many studies looking at the cross-sectional relationship between risk and stock return, the role of the human capital, real estate and bond in the market portfolio, has been ignored in those cross-sectional models. Based on these research gaps, the current study aims to advance the theoretical and empirical understanding of the role of non-marketable assets in composing the market proxy for the asset pricing model in the context of India.

India is one of the two most populous countries in the world with a total population of 1.39 billion. Its economy is the seventh largest in the world and it is becoming the world's fastest growing economy since the year 2014. In its pre-independent years, India's capital market had been made up of only a few companies and a small number of securities trading in the stock exchange. There were hardly any specialised intermediaries and agencies to mobilise the public's savings and investments. The market was mainly dominated by the government and semi-government securities, with only a few individual private investors which were confined to the affluent classes (Ahuja, 2012). Following its

independence in 1947, the country's capital market grew tremendously, as reflected by the increased volume of savings, investments and number of joint stock companies. Between the period of 1998 and 2016, there was an enormous growth, in terms of market capitalisation, index and foreign institutional investments (Srivastava & Ugrasen, 2017). The growth rate of its investments has been phenomenal in recent years as the country attracted more attention from investors around the world. This growth rate is in tandem with the accelerated tempo of the Indian economy's development that is driven by the country's five-year plan (Kulshrestha, 2014). Given this scenario, research looking at the capital market of India is expected to provide academics and practitioners with a better understanding of the cross-sectional behaviour of stock returns.

This paper specifically aims to compare the beta estimates that were obtained from a composite model. The market portfolio will include non-marketable assets such as returns of stock, bond, human capital and real estate, and this will then be compared with the standard CAPM market model which only comprises returns of stock. This paper also attempts to examine the sensitivity of the risk-return tradeoff for the different market portfolio compositions by combining the non-marketable assets which comprise returns on human capital, real estate, bond and stock. Since the dynamic property of time series requires parameters that are allowed to change over time, this paper also intends to enrich literature by further investigating the conditional composite model in the Indian context. The time-varying betas in the conditional model are estimated through the Kalman filter algorithm which uses three macroeconomic conditioning variables namely, index of industrial production (IIP), term spread and exchange rate.

The rest of this paper is organised as follows. Section 2 reviews prior literature relevant to this study. Section 3 explains the methodology employed while Section 4 presents the results. Section 5 discusses the findings and Section 6 concludes the paper.

## **2. Literature Review**

### ***2.1 Capital Asset Pricing Model (CAPM)***

The capital asset pricing model (CAPM) is a model that provides an estimate of a company's equity cost of capital or the expected rate of return on investments. The CAPM model has a strong theoretical basis; it is widely used in practical applications such as a company's internal

project decision and in the valuation of assets. Although the CAPM is widely practised, its empirical validity has not been conclusively supported (see Black, Jensen, & Scholes, 1972; Stambaugh, 1982). This is possibly due to the difficulties of implementing valid tests on the model (Fama & French, 2004). In the Sharpe-Lintner (Sharpe, 1964; Lintner, 1965) version of the CAPM, the market, as a whole, is treated as a macroeconomic variable and it is assumed as the portfolio of aggregate endowment (Athanasoulis & Shiller, 2000). In principle, however, the CAPM can include not just traded financial assets but also consumer durables such as real estate and human capital (Fama & French, 2004). Through his work, Mayers (1972) presented a single period mean-variance CAPM which allows two types of assets to co-exist: perfectly liquid (marketable) assets or perfectly illiquid (non-marketable) assets.

Mayers (1973) and Roll (1977) were among the first to define the market portfolio in the empirical testing of the CAPM. Mayers (1972) developed a generalised CAPM to account for the presence of non-marketable assets but Fama and Schwert (1977) later used Mayers' (1972) modified CAPM model to test the risk-return relationship. They did not find much difference in the risk-return relationship when human capital was included as a construct in the standard CAPM. Building on Mayers' (1972) model, Jagannathan and Wang (1996) and Campbell (1996) noted that human capital can create a significant fraction of aggregate wealth, hence they included a proxy, the return on human capital, to their asset pricing model. Jagannathan and Wang (1996) concluded that when the return on human capital is included in the conditional CAPM, the model is able to explain a significant part of the cross-sectional behaviour of the U.S.'s security returns. In contrast, Campbell (1996) found that by ignoring human capital in the long run, the CAPM overstates the risk of investing in stocks and understates the risk aversion coefficient which is needed to explain the risk premium. In their conditional consumption-based asset pricing model, Lettau and Ludvigson (2001) observed that the beta for labour income growth performed better in explaining the cross-sectional variation in returns. Following the Lettau and Ludvigson model, other researchers such as Dreyer, Schneider, and Smith (2013) incorporated human capital in the saving based asset pricing model. Their findings demonstrated that the empirical model of Consumption-Based Asset Pricing Model (CCAPM) with human capital fares poorly. In a recent paper, Eiling (2013) highlighted that the nature of human capital is investor-specific and it relies on variables such as age, education, occupation or the industry or company in which the investor

works. The previous study of Huerta (2003), however, used capital gain and skill premium as an approximation for growth rate in per capita labour income to evaluate the robustness of the conditional CAPM. He found human capital returns an important source which explains the cross-sectional variation in asset prices.

Proprietary income from entrepreneurial ventures or proprietary business also has a significant impact on asset prices (Heaton & Lucas, 2000). The proprietary income represents a source of undiversifiable risk which is correlated with common stock returns. Heaton and Lucas (2000) incorporated proprietary income as a source of risk into the conditional CAPM whereby the return of human capital is determined by the value of wage income and the value of proprietary income. They found an improvement in the performance of the asset pricing model when the aggregate proprietary income was added as a risk factor instead of just the labour income.

Housing or real estate investment is another important asset which cannot be liquidated for significant periods of time although it has the hedging characteristics that can go against the adverse shocks of labour income (Davidoff, 2006). In his study, Stambaugh (1982) examined the sensitivity of the CAPM to different proxies for the market portfolio. Corporate bonds, government bonds, treasury bills, home furnishings, residential real estates, automobiles and common stocks were considered for the different index composition of the market portfolios. He found that the various market index portfolios produced identical inferences about the CAPM in the U.S. market. Brown and Brown (1987) evaluated the performance of mutual funds that were relative to six different market proxies with a combination of stocks, bonds and real estates. They concluded that the composition of the market proxies provided a wide variety of inferences for the same set of funds.

In the context outside of the U.S. market, a few empirical studies were also conducted, for example, in Australia (Durack, Durand, & Maller, 2004) and the U.K. (Soufian, McMillan, & Horsburgh, 2013). These studies incorporated return on human capital in the conditional version of the CAPM. They found that extending the market portfolio to include the stock and human capital returns also do not improve the explanatory power of the model. Nevertheless, the performance of the CAPM specification is found to improve when labour income risk is considered, in the context of Japan (Jagannathan, Kubota, & Takehara, 1998). From the perspective of India, most studies conducted in the post liberalisation period, concluded that the risk-return relationship does

not explain the empirical testing value of the standard CAPM (Ansari, 2000; Dhankar & Singh, 2005; Sehgal, 1997). From his study, Majumder (2014) found that the results of the empirical tests done on the standard CAPM are consistent with the mixed empirical findings documented by earlier research which were performed in developed and emerging markets including Australia (Groenewold & Fraser, 2001), the U.S. (Chou & Zhou, 2006) and the OECD countries (Harvey & Zhou, 1993). In looking at the conditional CAPM, Narasimhan and Pradhan (2003) found that the CAPM fails in all the market portfolios except for the largest portfolio, where both the beta and price of risk, are allowed to vary over time. Recently, Shijin, Gopaldaswamy, and Acharya (2012) used a variant of Campbell's (1996) equilibrium multifactor model to examine the impact of human capital in the stock price pattern of India. They also identified human capital as a determining factor on the expected rate of return of securities.

## *2.2 Indian Capital Market*

The post-liberalisation era of India has seen an enormous growth in its capital market which is made up of the equities market and the debt market. The largest stock exchange in India is the Bombay Stock Exchange (BSE) which is also the oldest in India. More than 5500 companies are listed on the BSE, making it the world's No. 1 stock exchange in terms of listed companies. The BSE SENSEX is India's most widely tracked stock market benchmark index while the National Stock Exchange (NSE) is the leading stock exchange in India and the fourth largest in the world in 2015, going by the equity trading volume (World Federation of Exchanges – WFE)<sup>1</sup>.

The Indian capital market is regulated and monitored by the Securities and Exchange Board of India (SEBI) and the Reserve Bank of India (RBI), besides the Ministry of Finance, India. Through the adoption of advanced technology, the Indian capital market system is considered to be comparable with other international capital markets. The Economics Survey of 2015-2016 of the RBI states that the Indian economy will continue to grow by more than seven per cent between 2016-2017. India is noted to be one of the leading destinations for investors, whether domestic or global.

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<sup>1</sup> Source: <http://nseindia.com> and <http://bseindia.com>

Of the two types of markets noted in India's capital market, the debt market has been identified to comprise two categories – the government securities or the G-Sec, and the corporate bond market. The G-Sec provides the benchmark for determining the level of interest rates in the country; it is a major part of the market in terms of outstanding issues, market capitalisation and trading values. In India, derivative trading began in June 2000 and today, it is still growing, in terms of the number of contracts traded and its turnover over the years. Table 1 displays some facts of the Indian capital market between 1998-2016, showing its enormous growth in terms of market capitalisation, index and foreign institutional investment (FII).

Table 1: Facts on Indian Capital Market

India	1998-1999	2003-2004	2009-2010	2015-2016
BSE market capitalisation at the end of year (Rs. billion)	5453.61	12012.07	61656.20	94753.28
Annual turnover at BSE (Rs. billion)	3120.00	5026.18	13788.09	7400.89
BSE Sensex	3294.78	4492.19	15585.21	26322.10
Net investments by the FIIs (Rs. billion)	-7.29	440.00	1149.01	-48.82
Wholesale debt market turnover (Rs. billion)	1054.69	13160.96	5638.16	5694.95
Total turnover (BSE & NSE) in derivatives market (Rs. billion)		21426.84	176639.00	698272.60

Source: Reserve Bank of India database; USD1 = Rs.64.72.

### 3. Methodology

#### 3.1 Techniques

Since this study aims to test the CAPM model, two approaches can be used. One approach is to use a composite market proxy to represent a bigger proportion of the total wealth of the economy (Brown & Brown, 1987). Another approach is to use standard CAPM with added explanatory variables as additional risk factors (Eiling, 2013; Jagannathan & Wang, 1996). Mayers' (1972) model is identified as the extended model

of Sharpe-Lintner's (see above) CAPM; this model is based on the mean-variance theory.

In this study, Mayers' (1972) model was applied to calculate the composite beta for the market portfolio which consists of stock, bond, human capital and real estate. The cross-section of the asset returns was tested with Fama and Macbeth's (1973) regression method. The Kalman filter based approach was used to estimate the conditional factor loadings in the CAPM.

### 3.1.1 Mayers Extended Composite Model

In this study, the derivations used by Elton and Gruber (1984) were extended by including real estate and bond components as well as stock and human capital into Mayers' (1972) model. Following the derivations of Elton and Gruber (1984), the composite CAPM was described through a composite market portfolio  $r'_M$  as:

$$\bar{r}_i = r_f + \tilde{\beta}_i (r'_M - r_f) \tag{1}$$

The composite market portfolio includes both the marketable and non-marketable assets. Here,  $\tilde{\beta}_i$  or composite beta is defined as:

$$\tilde{\beta}_i = \frac{\text{cov}(r_i, r'_M)}{\text{var}(r'_M)} \tag{2}$$

In the above equations,  $r_i$  is the return on asset  $i$ ;  $r_f$  is the risk-free rate of return;  $r'_M$  is the return on the composite market portfolio. In the composite model (Equation 1), beta can be measured through the market model regression method. Equation 1 can be reorganised to yield an extended model whereby the premium per unit of risk is the same as standard CAPM (i.e., stock only in the market portfolio). This can be done by expanding  $r'_M$  in Equation 1 and arranging it as:

$$r_i = r_f + \beta_i^* (r_M - r_f) \tag{3}$$

where 
$$\beta_i^* = \frac{\text{cov}(r_i, r_M) + \frac{P_B}{P_M} \text{cov}(r_i, r_B) + \frac{P_H}{P_M} \text{cov}(r_i, r_H) + \frac{P_{RE}}{P_M} \text{cov}(r_i, r_{RE})}{\text{var}(r_M) + \frac{P_B}{P_M} \text{cov}(r_B, r_M) + \frac{P_H}{P_M} \text{cov}(r_H, r_M) + \frac{P_{RE}}{P_M} \text{cov}(r_{RE}, r_M)} \tag{4}$$

This beta is defined as the extended beta which is denoted by  $\beta^*$ . The details of the derivation are given in the Appendix. Here,  $r_M$

is the return on standard market portfolio which contains the stock index alone;  $r_B$ ,  $r_H$  and  $r_{RE}$  are the returns on bond, human capital and real estate, respectively. These have been excluded from the standard market portfolio;  $P_M$  is the market value of all the assets included in the standard market portfolio; and  $P_B$ ,  $P_H$  and  $P_{RE}$  are the market values of the bond, human capital and real estate, respectively. Equations 3 and 4 imply that the expected return on an asset depends on its covariance with the portfolio of marketable assets and its covariance with the portfolio of non-marketable assets. An investor needs to utilise these correlations of the different asset classes and market risks in order to construct the optimal portfolio and to be able to diversify the impact of the adverse shocks. Finally, the standard CAPM (i.e., CAPM with stock only in the market portfolio) can be described as:

$$\bar{r}_i = r_f + \beta_i(r_M - r_f), \text{ where, } \beta_i = \text{cov}(r_i, r_M) / \text{var}(r_M) \quad (5)$$

Comparing Equation 3 with Equation 5, the only difference found was the definition of risk measurement or beta. Fama and Schwert (1977) measured this risk in both Mayers' (1972) and Sharpe-Lintner-Black's (1984) models to see whether Mayers' model can improve the pricing of the marketable assets. The same procedure was followed in order to find the difference between the beta measured in the extended model ( $\beta_i^*$  in Equation 4) and the standard CAPM model ( $\beta_i$  in Equation 5) for the 25 portfolios sorted by size and book-to-market ratio. The standard CAPM market model beta was estimated by using the market model regression with stock index only. The above models showing the different beta are summarised in Table 2.

Table 2: Description of the Various Models

Model	Equation	Risk measure	Market definition
Composite model	1, 2	Composite beta, $\bar{\beta}$ (with multi-asset composition)	Composite market, $M'$ (includes both the marketable and non-marketable assets)
Extended model	3, 5	Extended beta, $\beta^*$ (with multi-asset composition)	Standard market, $M$ (reorganised to include stock only)
Standard model	5	Standard beta, $\beta$ (with stock only)	Standard market, $M$ (includes stock only)

### 3.1.2 Fama-MacBeth Cross-sectional Regression

To examine the risk-return trade-off for the different market compositions, Fama-Macbeth's cross sectional regression method was applied. The betas for the different market indices were estimated by the time-series regression and the subsequent cross-sectional regressions were performed to find the pricing influence on the market indices. In other words, the formula for any asset  $i$ :

$$E(R_{i,t}) = \lambda_0 + \lambda_1 \beta_{i,t} + \varepsilon_{i,t} \quad (6)$$

Here,  $R_{i,t}$  denotes excess return on asset  $i$  for the month  $t$ .  $\beta_{i,t}$  is similarly defined in Equation 2 at the time  $t$ . Testing the validity of the CAPM implies testing the hypotheses which state that: (a) the intercept  $\lambda_0$  is equal to zero and (b) the risk premium  $\lambda_1$  is positive and significantly different from zero. The estimated betas in the time-series regressions have a measurement error which can be reduced by using Shanken's (1992) corrected standard error in the cross-sectional regression.

Equation 6 forms the basis for the cross-sectional test of the CAPM. The purpose is to find out whether the inclusion of additional assets in the market portfolio improves the asset pricing risk-return trade-off. The test of Equation 6 is interpreted as the test of efficiency of the index. The additional factors may help to improve the estimate of the "true" market portfolio by accounting for the missing assets (Chen, Roll, & Ross, 1986). In the first stage, returns from the past 18 to 54 months were used to estimate the beta which was assumed to remain constant for the next one year. The cross-sectional model, with the excess realised returns, is described as:

$$R_{i,t} - r_{f,t} = \lambda_{0,t} + \lambda_{1,t} \hat{\beta}_{i,t-1} + \alpha_{i,t} \quad i = 1, 2, \dots, N \text{ for each } t \quad (7)$$

For conditional asset pricing, the conditional betas were estimated by using Kalman's filter method. This is then followed by the estimated betas which were used in Equation 7 to test the efficiency of the various composite indices. There are two estimates in the model. The null hypothesis of the model's intercept says that there is no abnormal returns i.e.,  $\lambda_0 = 0$  and the alternative hypothesis for slope  $\lambda_1$  is significant and positive.

### 3.1.3 Modelling Conditioning Asset Pricing

The conditional CAPM implies that expected return is a function of the conditional betas multiplied by the conditional risk premium. In estimating the conditional betas, the IIP, dollar exchange rate and the 10-year term spread, were considered the conditioning information variables. In the first stage, the dynamic beta was estimated by using Kalman's filter method. The measurement and the state equations for the conditional CAPM which consist of three conditioning variables, are given as:

a) Measurement Equation:

$$R_{i,t} - r_{f,t} = a_{i,t} + \beta_{i,t}(R_{m,t} - r_{f,t}) + \varepsilon_{i,t} \quad t = 1, 2, \dots, T \text{ for each } i \quad (8)$$

b) State Equation:

$$a_i = \varphi_1 a_{i,t-1} + \eta_{1,t-1} \quad (9)$$

$$\beta_i = \varphi_2 \beta_{i,t-1} + b_1 IIP_{t-1} + b_2 TERM_{t-1} + b_3 EX_{t-1} + \eta_{2,t-1}$$

Here,  $a_t$  and  $\beta_t$ , follow an autoregressive process, and  $\beta_t$  is also a function of the IIP, term spread, exchange rate and past beta. The cross-sectional regressions on the estimated betas were performed on a monthly basis per Equation 7. Further details of the modelling conditional CAPM can be found in Das (2015).

## 3.2 Data

The empirical testing of Mayers' (1972) model requires time series return as well as the total value of the marketable and non-marketable assets. The proxy for the true market portfolio was a weighted average return of the common stock index, government bond index, return on human capital and return on real estate. The conditional CAPM requires data for the IIP, term spread and exchange rate. All the data for the conditioning variables were taken from the database of the Reserve Bank of India (RBI). The term spread was calculated as the difference between the 10-year G-Sec bond yields minus the 91 days T-Bill yield. The IIP and exchange rate data were transformed into the monthly rates of change and the test assets which comprise 25 portfolios were sorted by size and book-to-market ratio. The study was conducted over a 15-year period from 1998 to 2013. This period is important because the

stock market in India during this period was considered to be matured enough, after liberalisation in 1990-91. At that time, the stock market was integrated with other stock markets around the world (Narayan, Srianthakumar, & Islam, 2014).

### 3.2.1 *Stock Data*

The stock data for this study were taken from all the non-financial companies that were listed on the Bombay Stock Exchange (BSE) from October 1998 to September 2013. For each year starting from October, companies whose monthly return data were available for the past 24 months, were chosen. Based on this criteria, the number of companies varied from a minimum of 492 (October, 1998) to a maximum of 1808 (October, 2010). Upon adjusting the prices for the dividends, stock split and other corporate actions, there was a total of 180 monthly returns. Companies which were not included as samples were those that had low level trading or those that did not have financial information on a continuous basis. All the data about the stock returns and other firm-specific information were collected from the Prowess database, which is a firm level financial database that is maintained by the Center for the Monitoring of the Indian Economy (CMIE), a leading business information company. The equity index of the S&P, BSE and SENSEX, India's most widely tracked stock market benchmark index, was used as a proxy for the stock market portfolio. The total market value of the SENSEX ( $P_M$ ) was obtained from the CMIE database.

### 3.2.2 *Bond Index Data*

The government bond market index data were available from the National Stock Exchange (NSE) database. The composite index which covers all the sectors were considered for the monthly bond data, from October 1998 to September 2013. Corporate bond was not considered because they were under developed in India at that time. The total market value of the bond index ( $P_B$ ) was also obtained from the NSE wholesale debt market database.

### 3.2.3 *Test Portfolios*

Twenty five portfolios were constructed based on market size and book-to-market equity ratio (B/M). The portfolio returns were value-weighted

returns that resulted from the intersections of five size-sorted portfolios and five B/M-sorted portfolios. The portfolios were constructed at the end of September in each year. The six-month gap between the fiscal year end and the portfolio return formation, was maintained, following Fama and French (1992).

The portfolios were formed in October of each year. The size of a company was calculated at the end of September each year. The B/M ratio was calculated as the book value of the stockholders' equity for the fiscal year ending in March and it was divided by the market equity at the end of March of the same year. This procedure was repeated to calculate the portfolio return for every calendar year, from October 1998 to September 2013. For each year, stocks were assigned into five portfolios of size-based on their market capitalisation value at the end of September. Similarly, all the stocks were independently sorted into five portfolios of book-to-market equity, based on their B/M ratio calculated in March. Through this method, 25 value-weighted portfolios were formed at the intersection of size and book-to-market ratio. While sorting, the portfolios were formed based on the number of stocks available within each breakpoint. The negative book equity noted in any portfolio was excluded from consideration. Repeating this procedure for every year from October 1998 to September 2013 generated a total of 180 value weighted monthly returns.

### *3.2.4 Measuring Human Capital Returns*

Human capital is the present value of income noted from future labour work. The returns on human capital are difficult to estimate as discount rate on human capital is unobservable. To explain the cross-section of the expected returns in previous empirical testing, Jagannathan & Wang (1996) used growth rate in per capita labour income as proxies for the aggregate human capital. Another study, Eiling (2013), measured the contemporaneous growth rate of the industry-level labour income to estimate the industry-specific human capital returns. She concluded that heterogeneity in human capital at the industry level affects the cross-section of expected stock returns. In the context of India, the labour component of the gross national product (GNP) was used to measure the return on human capital (Shijin et al., 2012). The wage rates of agricultural labour in rural India were also used as the industry-specific labour income, similar to Eiling (2013). This is justified as agricultural labour make up 34 per cent of the total labour force in

India.<sup>2</sup> The growth rate in per capita wage income was calculated as the return on human capital. In India, daily wage rates, in respect of 18 agricultural and non-agricultural occupations, spread over 20 states, were being collected by the National Sample Survey Organization (NSSO). The RBI database also provides the wage rates for agricultural and non-agricultural labour in rural India. In this study, the agricultural income was employed as proxy for human capital data, thus the total market value of the agricultural products, during the same period, was needed. To calculate the total market value of the agricultural products ( $P_H$ ), the agriculture value added per worker from the World Bank data was obtained. Agriculture value added per worker is a measure of the agricultural productivity (percentage of the GDP). Therefore, this was taken as the total market value of the agricultural product.

### 3.2.5 *Measuring Real Estate Returns*

In the capital market, real estate investment differs from other risky investments in that it is heterogeneous, is relatively illiquid and the property value depends on local factors. Moreover, real estate investment also bears the dual role of being a consumption asset as well as an investment asset. The price on real estate was determined by the changes in the expected cash flow due to change in price with a discount factor. However, pricing data availability for the real estate in the Indian market is poor. The returns are available only for longer intervals like annual or semi-annual. Stambaugh (1982) estimated the return on residential real estate to be the percentage change in the home purchase component of the U.S. Consumer Price Index (CPI). Following Stambaugh (1982), this study employed the housing component of the CPI data. For compilation of house rent index in the housing group of CPI, the actual rents of the rented houses and the comparable rents for owner occupied houses in each of the selected towns were also taken into consideration for the CPI. The rent index was calculated once in every six months viz., January and July. This was kept constant for the next five months. All these semi-annual data were then converted into monthly data through the spline interpolation. The return on the real estates was calculated to be the change in the housing component. To calculate the total market value of the real estate ( $P_{RE}$ ), value added by the real estate, ownership of dwellings and business services activity

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<sup>2</sup> Source: Indian Labour Statistics reports 2012 and 2013, Ministry of Labour and Employment.

taken from the Ministry of Statistics and the Program Implementation (MOSPI) data, were applied.

## 4. Results

### 4.1 Descriptive Statistics for Index Components

Table 3 reports the descriptive statistics for the monthly return on the market index components viz., stock index, government bond index, real estate and human capital. As can be noted, the stock index has a high mean return (1.29 per cent per month) and high standard deviation (7.39 per cent per month) compared to other factors. The autocorrelation coefficient for the first lag was also computed. Result shows a significant coefficient value for all the returns except stock and composite market return.

The correlation matrix, based on the monthly returns of the market index component, indicates that none of the coefficients is significant. The negative coefficient between stock and bond index returns suggests that the increased stock market uncertainty had resulted in the negative co-movements between bond and stock returns (Bansal, Connolly, & Stivers, 2014). The positive coefficient between real estate and stock index returns is due to the real estate and stock prices, which were both affected by the current economic fundamentals of the economic activity (Quan & Titman, 1999).

Table 3: Descriptive Statistics for Monthly Data on Index Component Returns

Asset	Mean (%)	Standard deviation (%)	Min (%)	Max (%)	$\rho_1$	Stock index	Bond index	Real estate	Human capital
Stock index	1.29	7.39	-23.89	28.25	0.07	1			
Bond index	0.59	1.69	-4.55	11.07	0.16	-0.122	1		
Real estate	0.78	1.17	-0.99	6.40	0.64	0.133	0.060	1	
Human capital	0.69	1.10	-8.58	3.94	0.22	-0.010	-0.020	0.043	1

Note: Autocorrelation coefficient  $\rho_1$  is the first lag for the returns on market portfolio components.

#### 4.2 Comparison of Beta Estimates

In this section, beta was measured by the extended asset pricing model ( $\beta^*$ ) as noted in Equation 4 and by the standard model ( $\beta_i$ ) as noted in Equation 5, for 25 portfolios which were sorted by size and book-to-market ratio. Like before, the only difference noted between Equation 4 and Equation 5 is how the beta was measured. In Equation 4, the extended beta was calculated on covariance, variance terms and the total value of all the marketable assets. In Equation 5, the beta was estimated as a slope coefficient of the market model regression of the portfolio return on stock index return. If these differences are large, then non-marketable assets like bond, human capital and real estate should be an important factor in the pricing. Nonetheless, Table 4 reports the average beta for all these models as well as their differences noted for all the 25 portfolios. Here, the table also reports the full sample regression composite beta for the composite model ( $\bar{\beta}$  in Equation 2), when all the marketable and non-marketable assets were included in the market portfolio.

With exception to the last column shown in Table 4, this study finds that there is a significant difference in the beta values between column 2 and column 3, for all the 25 portfolios, when per unit of risk premium is equal. The difference noted in the average value of the beta indicates a difference in the expected returns (obtained from the extended model and the standard CAPM model). In addition, the beta values of all the portfolios for the extended model are less than those of the standard model CAPM. The minimum difference noted is 0.034 and the maximum difference noted is 0.224. This implies that, had this study used standard beta (instead of extended beta), then the expected return would have been overstated, from 3.4 per cent to 22.4 per cent. The full sample regression beta for the composite model was in the range of 2.652 to 3.872.

#### 4.3 Cross-sectional Regression Test

In this section, the risk-return trade-off was evaluated in explaining the variation in the expected returns across assets for the different market portfolio composition. The panels with the different market proxies are summarised as follows: Panel A (CAPM with stock only); Panel B (CAPM with stock and bond); Panel C (CAPM with stock and human capital); and Panel D (CAPM with stock, human capital and real estate).

Table 4: Comparison of Mayers' Extended Model Beta and CAPM Beta

Portfolio	Extended model beta ( $\beta^*$ )	Standard beta ( $\beta$ )	Difference (Column 2 - 3)	Composite beta ( $\tilde{\beta}$ )
S1B1	0.877	1.036	-0.159*	2.945
S1B2	0.840	0.995	-0.155*	2.814
S1B3	0.828	0.986	-0.158*	2.773
S1B4	0.770	0.962	-0.192*	2.652
S1B5	0.910	1.134	-0.224*	3.040
S2B1	0.949	1.105	-0.156*	3.312
S2B2	0.964	1.082	-0.118*	3.304
S2B3	0.984	1.104	-0.120*	3.237
S2B4	0.995	1.098	-0.103*	3.420
S2B5	0.952	1.148	-0.196*	3.492
S3B1	1.067	1.204	-0.137*	3.708
S3B2	0.958	1.063	-0.105*	3.436
S3B3	0.972	1.095	-0.123*	3.386
S3B4	1.016	1.138	-0.122*	3.639
S3B5	1.046	1.199	-0.153*	3.636
S4B1	1.105	1.188	-0.083*	3.872
S4B2	1.002	1.091	-0.089*	3.544
S4B3	0.961	1.061	-0.100*	3.475
S4B4	1.012	1.123	-0.111*	3.485
S4B5	1.076	1.181	-0.105*	3.802
S5B1	0.948	1.008	-0.060*	3.063
S5B2	0.901	0.987	-0.086*	2.953
S5B3	1.024	1.114	-0.090*	3.417
S5B4	1.009	1.043	-0.034*	3.327
S5B5	1.116	1.155	-0.039	3.763

Notes: The table reports the beta that was estimated by the extended model and the standard model as well as their differences for the 25 portfolios. The extended beta was calculated from Equation 4; the standard beta was estimated using the full sample regression in Equation 5, whereas the composite model beta was estimated from Equation 1. The portfolios were numbered as S1B1 to S5B5. S1 refers to the lowest 20% value of the market capitalisation, S5 refers to the largest 20% value of the market capitalisation. B1 refers to the lowest 20% value of the B/M ratios and B5 refers to the largest 20% value. The period analysed was from April 2000 to September 2013. The \* indicate significance at the 5% level.

Panel A of Table 5 reports the cross-sectional regression results when stock index is the only component of the market portfolio. The insignificant value of the t-statistics for risk premium indicates that the CAPM is not suitable for the Indian stock market. Panel B indicates that there is no considerable change in the results even when bond index is added to the stock index, as true market portfolio. Similarly, in Panel C, the addition of human capital to the market composition also does not change the inferences. In Panel D, the absolute values of the coefficients also appear to be similar to the previous panels when stock, bond, real estate and human capital are included. This study notes that the average monthly risk premium per unit of the beta is 0.6 per cent for stock alone but it is -0.2 per cent for stock, bond, human capital and

Table 5: Fama-Macbeth’s Cross-Sectional Regression Result

Parameter	$\hat{\lambda}_0$	$\hat{\lambda}_1$	Adj-R <sup>2</sup>	$\chi^2$ statistic ( <i>p</i> -value)
<i>Panel A: CAPM with stock only</i>				
Mean	0.005	0.006	18%	38.20
Standard deviation	0.190	0.183		(0.024)
t-stat	0.344	0.415		
Shanken t-stat	0.343	0.414		
<i>Panel B: CAPM with stock and bond</i>				
Mean	0.028	-0.004	13%	42.90
Standard deviation	0.197	0.072		(0.007)
t-stat	1.820	-0.731		
Shanken t-stat	1.804	-0.726		
<i>Panel C: CAPM with stock and human capital</i>				
Mean	0.004	0.004	17%	41.59
Standard deviation	0.181	0.081		(0.010)
t-stat	0.289	0.633		
Shanken t-stat	0.288	0.631		
<i>Panel D: CAPM with stock, bond, human capital and real estate</i>				
Mean	0.022	-0.002	13%	44.29
Standard deviation	0.193	0.048		(0.005)
t-stat	1.489	-0.477		
Shanken t-stat	1.484	-0.475		

Notes: The  $\chi^2$  statistic is calculated for the joint pricing error test.

\* indicates the values are significant at the 5% level.

real estate altogether. The different market indices do not explain the cross-sectional differences in the average returns. In all the panels, the insignificant t-statistics shown for the intercept implies that the null hypothesis of no abnormal return cannot be rejected. In all the three cases of Panels A, B and C, a small excess of expected return is accomplished for the non-risk investments. The  $\chi^2$  statistic tests the null hypothesis which states that all pricing errors are jointly equal to zero. The significant  $p$ -values rejects the model at the 5 per cent significance level in all the panels. The absolute  $\chi^2$  value of the pricing error is greatest when stock, bond, real estate and human capital constituted the market proxy. To compare the different model specifications, the cross sectional adjusted-R<sup>2</sup> was applied as an informal measure. The low R<sup>2</sup> values does not provide a satisfactory explanation for the cross-section of returns. Only 13 to 18 per cent of the variation of average return is explained by the model.

#### *4.4 Cross-sectional Regression Test for Conditional Model*

This study further investigated the role of the conditioning variables for the different combinations of market portfolios. In this regard, the time-varying beta was estimated to examine whether such extensions can offer a better explanation for the risk–return relationship. Table 6 reports the results for the set of 25 portfolios (which were sorted by size and book-to-market ratio) on the conditional CAPM that uses different market portfolio compositions. This study finds that the conditional CAPM is able to explain the risk-return relationship with a positive and significant beta. However, the various market portfolio compositions does not have an impact on the cross-sectional relationship. This is in line with the unconditional CAPM case which shows no influence of bond, real estate and labour income on the proxy for the complete market.

## **5. Discussion**

The extended beta noted in Equation 4 is a ratio of the weighted average of covariance terms. These covariance between two assets are more important for determining the systematic risk or the beta than individual returns of the assets. This study compared the beta of the extended model ( $\beta^*$ ) with the standard CAPM ( $\beta$ ) for equal equity premium. It

Table 6: Conditional Fama-Macbeth's Cross-Sectional Regression Result

Parameter	$\hat{\lambda}_0$	$\hat{\lambda}_1$	Adj-R <sup>2</sup>	$\chi^2$ statistic ( <i>p</i> -value)
<i>Panel A: CAPM with stock only</i>				
Mean	-0.047	0.048	21%	62.79
Standard deviation	0.075	0.089		(0.000)
t-stat	-7.207*	6.683*		
Shanken t-stat	-6.103*	6.303*		
<i>Panel B: CAPM with stock and bond</i>				
Mean	-0.044	0.021	23%	86.05
Standard deviation	0.080	0.033		(0.000)
t-stat	-6.982*	8.036*		
Shanken t-stat	-5.705*	7.637*		
<i>Panel C: CAPM with stock and human capital</i>				
Mean	-0.031	0.018	19%	98.32
Standard deviation	0.079	0.039		(0.000)
t-stat	-4.975*	6.050*		
Shanken t-stat	-4.481*	6.016*		
<i>Panel D: CAPM with stock, bond, human capital and real estate</i>				
Mean	-0.041	0.014	22%	80.37
Standard deviation	0.078	0.022		(0.000)
t-stat	-6.713*	8.396*		
Shanken t-stat	-5.544*	8.235*		

Notes: The  $\chi^2$  statistic is calculated for the joint pricing error test.  
 \* indicates the values are significant at the 5% level.

is found that the betas in the extended model are less than the betas in the standard CAPM market, across all the portfolios. In India, generally, only stock prices respond quickly to public information while bond, human capital and real estates, do not behave in the same way. The correlation matrix shown in Table 4 indicates that the assets are not really correlated to each other. Hence, the denominator is less than the numerator in Equation 4.

The unconditional CAPM fails to validate the implications of the empirical testing of the CAPM. Although this study found a difference in the betas of the extended and standard market models, there is no difference in the inference for the different market proxies. The market factor is not priced for the unconditional model. The risk and

return models that are used to analyse the different asset classes may not be suitable because of the differences in liquidity across the assets and in the types of investors noted in each market. Returns of the less liquid assets like human capital and real estate move slowly, relative to the equity returns, thus their presence reduces the variability of the composite market returns when compared to the standard (i.e., stock only) market returns. The inability to explain the variation in the average returns across the portfolios implies that the multi-asset market proxy is not a mean-variance efficient portfolio. Similar to Stambaugh (1982), this study finds that the cross-sectional regression slope coefficients declines as stocks receive less weight in the composite market index and as standard errors decline in the same proportion. Hence, the inference does not change with the market index. The decline in the slope coefficients also matches the increase in the estimated beta values.

The average composite beta with stock, bond, real estate and human capital for the unconditional model is 3.34. This result is similar to the study done by Stambaugh (1982). This is because the average returns of the bond, real estate and human capital are lower than the average returns of the stock index, as shown in Table 3.

These results are related to the results observed in developed markets e.g., Australia (Durack et al., 2004), U.K. (Soufian et al., 2013), U.S. (Stambaugh, 1982) and emerging markets (e.g., Blitz, Pang, & Vliet, 2013) contexts. The cross-sectional test results for the unconditional model show that slope and intercept are insignificant whereas both slope and intercept are significant in the conditional model. Therefore, it is concluded that investors' decision is frequently guided by the information contents, which might be the implicit factor behind the expected stock returns through time. However, the inclusion of real estate or human capital does not improve the risk-return relationship, which is unlike previous findings (e.g., Eiling, 2013; Heaton & Lucas, 2000). The difference noted in the results could be due to the fact that previous studies had used proprietary income and industry-specific labour income growth as a proxy for real estate and human capital respectively.

## 6. Conclusions

This paper had considered a multi-asset proxy for the true market portfolio and this was composed of stock index, government bond index, human capital and real estate. The cross-sectional relation between

risk and expected returns for both the conditional and unconditional composite models was examined. To find the importance of the non-marketable assets, this study also compared the beta which was measured by the extended model (i.e., with multi-asset composition) and the standard CAPM (i.e., with stock only); both used the same risk premium for 25 portfolios which were sorted by size and book-to-market ratio.

The comparison of beta suggests that the different market portfolio compositions had overestimated the beta that was estimated by the composite market portfolio model. Therefore, an investor should be more cautious when formulating expectations of future returns through the composite market beta. The cross-sectional test results for the unconditional CAPM model also indicates that the market factor is not able to explain the risk-return relationship. This study found that conditional CAPM is able to explain the risk-return relationship, thereby implying the importance of conditioning variables in India for the investor's conditional expected returns. This highlights that investors use past market information to forecast the cost of capital. However, in both cases, adding the non-marketable assets of bond, human capital and real estate to the market portfolio, does not have much impact on the empirical testing of the CAPM. Besides stock, the inclusion of bond, real estate and human capital to proxy a complete market portfolio also does not change the inferences on the risk-return tradeoff. This implies that in the Indian market, the market portfolio is not mean-variance efficient, as pointed out by Roll (1977) who cautioned that the validity of risk-return relation is equivalent to the mean-variance efficiency of the market portfolio. The results on the composite market portfolio in India therefore, support the results of other developed markets.

This paper contributes to the literature by undertaking the robustness testing of asset pricing models with conditional and unconditional CAPM which uses a multivariate market proxy to address Roll's (1977) criticism. The empirical research done on asset pricing tried to explain the extent by which stock returns can be analysed through theory. The major challenge faced in asset pricing is the issue of achieving a statistical efficiency coupled with economical interpretation. Other limitations identified from this study are the restricted stock data which were confined to the period from 1998 to 2013. This is inevitable because prior to 1998, based on this study's stock selection criteria, the number of companies would have been fewer, hence the number of companies that can be included in each portfolio, would have been further reduced, and this would have defeated the purpose of this study. Another limitation

is the unavailability of data related to human capital and real estate. In this study, there was no proper measure of human capital which was related to the market-based valuation. In addition, the housing index was also a new variable in India which were only available from the year 2007. Moreover, these data were also updated semi-annually. Despite these limitations, this study had tried its best to replicate the true market portfolio composed of stock index, government bond index, human capital and real estate with as much data as possible.

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## Appendix

### Extension of Mayers model

Following the derivation of Elton and Gruber (1984), the standard CAPM is described with a true market portfolio  $r'_M$  as:

$$\bar{r}_i = r_f + \frac{\text{cov}(r_i r'_M)}{\text{var}(r'_M)} (\bar{r}'_M - r_f) \tag{A1}$$

The return on the true market portfolio is a weighted average of the return on those assets which have been included in the incomplete market portfolio and return on those assets which have been excluded from the market portfolio. For four assets case, we can write the true market portfolio return as:

$$r'_M = \frac{P_M}{P_M + P_B + P_H + P_{RE}} r_M + \frac{P_B}{P_M + P_B + P_H + P_{RE}} r_B + \frac{P_H}{P_M + P_B + P_H + P_{RE}} r_H + \frac{P_{RE}}{P_M + P_B + P_H + P_{RE}} r_{RE} \tag{A2}$$

Substituting equation (A2) into equation (A1), we have:

$$\bar{r}_i = r_f + \left[ (\bar{r}'_M - r_f) + \left( \frac{P_B}{P_M} \right) (\bar{r}'_B - r_f) + \left( \frac{P_H}{P_M} \right) (\bar{r}'_H - r_f) + \left( \frac{P_{RE}}{P_M} \right) (\bar{r}'_{RE} - r_f) \right] \left[ \frac{\text{cov}(r'_i r'_M) + \left( \frac{P_B}{P_M} \right) \text{cov}(r'_i r'_B) + \left( \frac{P_H}{P_M} \right) \text{cov}(r'_i r'_H) + \left( \frac{P_{RE}}{P_M} \right) \text{cov}(r'_i r'_{RE})}{\text{var}(r'_M) + \left( \frac{P_B}{P_M} \right)^2 \text{var}(r'_B) + \left( \frac{P_H}{P_M} \right)^2 \text{var}(r'_H) + \left( \frac{P_{RE}}{P_M} \right)^2 \text{var}(r'_{RE}) + 2 \left( \frac{P_B}{P_M} \right) \text{cov}(r'_M r'_B) + 2 \left( \frac{P_H}{P_M} \right) \text{cov}(r'_M r'_H) + 2 \left( \frac{P_{RE}}{P_M} \right) \text{cov}(r'_M r'_{RE})} + 2 \left( \frac{P_B}{P_M} \right) \left( \frac{P_H}{P_M} \right) \text{cov}(r'_B r'_H) + 2 \left( \frac{P_H}{P_M} \right) \left( \frac{P_{RE}}{P_M} \right) \text{cov}(r'_H r'_{RE}) + 2 \left( \frac{P_{RE}}{P_M} \right) \left( \frac{P_B}{P_M} \right) \text{cov}(r'_{RE} r'_B) \right] \tag{A3}$$

This equation must hold for all risky assets, including the market portfolio (i.e.,  $\bar{r}_i = \bar{r}'_M$ ) of risky assets. Replacing  $\bar{r}_i = \bar{r}'_M$  and then rearranging we get:

$$\frac{\bar{r}'_M - r_f}{\text{var}(r'_M) + \left( \frac{P_B}{P_M} \right) \text{cov}(r'_M r'_B) + \left( \frac{P_H}{P_M} \right) \text{cov}(r'_M r'_H) + \left( \frac{P_{RE}}{P_M} \right) \text{cov}(r'_M r'_{RE})} = \left[ \frac{(\bar{r}'_M - r_f) + \left( \frac{P_B}{P_M} \right) (\bar{r}'_B - r_f) + \left( \frac{P_H}{P_M} \right) (\bar{r}'_H - r_f) + \left( \frac{P_{RE}}{P_M} \right) (\bar{r}'_{RE} - r_f)}{\text{var}(r'_M) + \left( \frac{P_B}{P_M} \right)^2 \text{var}(r'_B) + \left( \frac{P_H}{P_M} \right)^2 \text{var}(r'_H) + \left( \frac{P_{RE}}{P_M} \right)^2 \text{var}(r'_{RE}) + 2 \left( \frac{P_B}{P_M} \right) \text{cov}(r'_M r'_B) + 2 \left( \frac{P_H}{P_M} \right) \text{cov}(r'_M r'_H) + 2 \left( \frac{P_{RE}}{P_M} \right) \text{cov}(r'_M r'_{RE})} + 2 \left( \frac{P_B}{P_M} \right) \left( \frac{P_H}{P_M} \right) \text{cov}(r'_B r'_H) + 2 \left( \frac{P_H}{P_M} \right) \left( \frac{P_{RE}}{P_M} \right) \text{cov}(r'_H r'_{RE}) + 2 \left( \frac{P_{RE}}{P_M} \right) \left( \frac{P_B}{P_M} \right) \text{cov}(r'_{RE} r'_B) \right] \tag{A4}$$

Substituting equation (A4) into equation (A3) and simplifying we have

$$\bar{r}_i = r_f + \frac{(\bar{r}_M - r_f) \left[ \text{cov}(r_i r_M) + \frac{P_B}{P_M} \text{cov}(r_i r_B) + \frac{P_H}{P_M} \text{cov}(r_i r_H) + \frac{P_{RE}}{P_M} \text{cov}(r_i r_{RE}) \right]}{\text{var}(r_M) + \frac{P_B}{P_M} \text{cov}(r_B r_M) + \frac{P_H}{P_M} \text{cov}(r_H r_M) + \frac{P_{RE}}{P_M} \text{cov}(r_{RE} r_M)} \quad (\text{A5})$$