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Innovations in the Future Money Growth and the Cross-Section of Stock Returns in Korea

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Abstract

This paper proposes revisions in the expectation of future money growth as a macroeconomic state variable in the perspective of Merton's (*Econometrica*, 41, 1973, 867) intertemporal capital asset pricing model, and examines whether the factor related with innovations in the expectation of future money growth is priced on stock returns in the Korean stock market after controlling for the market factor, Fama and French's *SMB* and *HML*, and the momentum factor. In both the cross-sectional regression tests and the generalized method of moments tests, regardless of the inclusion of the well-known priced factors, we find that the future money growth factor is significantly priced, even after controlling for the other macroeconomic factors. The significance of the future money growth factor becomes stronger in the period after the Asian foreign currency crisis than before the crisis.

Keywords Future money growth; Economic tracking portfolios; Firm size; Book-to-market; Cross-sectional regression tests; Macroeconomic variables

JEL classification: *G12*

1. Introduction

A linkage between future values of macroeconomic variables and stock returns is one of the most interesting topics among financial economists and practioners because macroeconomic variables are regarded as state variables and their changes affect firm values through the influence on firms' cash flows and discount rate. According to Merton (1973), unexpected (or stochastic) changes in state variables could cause unfavorable shifts in the investment opportunity set, and there will be

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risk associated with innovations in the state variables. Among many researchers who suggest a macroeconomic variable as a state variable, Merton (1973) regards the risk-free interest rate as an observable state variable and suggests the intertemporal capital asset pricing model. Vassalou (2003) uses innovations in the expectation of future *GDP* growth, and Kim *et al.* (2011a) use innovations in the expectation of future labor income growth as a state variable.

In the present paper, we propose revisions (or innovations) in the expectation of future money growth as such a macroeconomic state variable. The reasons we choose future money growth as a source of risk and a state variable of investors' hedging concerns are as follows. First, money supply is apparently one of the sources that affect macroeconomic conditions and business cycle fluctuations. This, in turn, affects investors' investment opportunity set. Second, money supply determines the macro-level liquidity. There is ample evidence that the liquidity shock is associated with aggregate asset prices during identified asset price boom/bust periods (Adalid and Detken, 2007). Third, expected changes in future money growth should provide information about the changes in firms' market value. Therefore, revisions in the expectation of future money growth could capture a relevant state variable and source of risk. Fourth, unexpected changes (or innovations) in the future money growth cause changes in consumers' expenditure that affect firms' revenue and cash flow. This induces changes in the investment opportunity set. Thus, investors would demand a greater risk premium for assets whose cash flows are more sensitive to innovations in future money growth. Fifth, although money supply is one of the most important macroeconomic activities, this factor has never been formally considered in asset pricing models in the Korean literature. We use *future* money growth as a state variable rather than *current* money growth because investors react more preemptively to news about innovations in future money growth than to news about current money growth.

In the present paper, we examine whether innovations in the expectation of future money growth is priced on stock returns in Korea after controlling for the market factor, Fama and French's (1993) *SMB* and *HML*, and Jegadeesh and Titman's (1993) momentum factor. In order to obtain the risk factor that captures innovations in the expectation of future money growth, which is unobservable, we adopt the economic tracking portfolio approach introduced by Lamont (2001). Economic tracking portfolios are designed to capture unexpected returns that are maximally correlated with unexpected components (or news) of a target macroeconomic variable. We use narrow money, M1, as a measure of money supply, because M1 can be immediately converted into currency or used for cashless payment and has an immediate impact on the status of money market liquidity. We use 3-month ahead future money supply growth rates for the future money growth.

In both the cross-sectional regression tests and the generalized method of moments (GMM) tests, we find that the factor related with innovations in the expectation of future money growth is significantly priced in Korea, even after controlling for the well-known factors such as the market factor, Fama and French's

SMB and *HML*, and the momentum factor. Thus, the future money growth factor has a significant marginal contribution in pricing stocks in Korea, which implies that it captures an economic risk that *SMB* and *HML* do not. We also find that this economic risk is related to term spread and default spread. The pricing ability of the future money growth factor is robust even after controlling for the real macroeconomic variables such as *GDP*, industrial production, anticipated inflation, and unanticipated inflation. We conduct several robustness checks. Because the above results are sensitive to the choice of the base assets, we use different base assets for the purpose of robustness check. The results are qualitatively similar. Another interesting finding is that the money growth factor is significantly priced over the period after the Asian currency crisis, but is insignificantly priced over the period before the crisis. This indicates that the future macro liquidity shock, measured by the 3-month ahead future money supply growth, plays a significant role in determining investors' expectation of stock returns in Korea after the Asian currency crisis.

The rest of this paper is organized as follows. Section 2 discusses the methodology for estimating the economic tracking portfolio returns and for testing the significance of the models. Section 3 describes the data, and Section 4 reports the empirical results. Section 5 concludes.

2. Methodology

2.1. Economic Tracking Portfolio Approach

Returns of an economic tracking portfolio for a macroeconomic variable y such as the money growth can be obtained as the fitted value of a regression of y on a set of base asset returns. The target variable is "news" about y_{t+s}, where y_{t+s} is a macroeconomic variable in the future time $t + s$, such as the money growth rate in time $t + s$, and s denotes the forecast horizon. News is defined as innovations in expectations about y_{t+s}, with notation $\Delta E_t(y_{t+s}) = E_t(y_{t+s}) - E_{t-1}(y_{t+s})$, where $\Delta E_t(y_{t+s})$ describes changes in expectations. The realization of the macroeconomic variable y_{t+s} can be written as:

$$y_{t+s} = E_t(y_{t+s}) + e_{t,t+s} = E_{t-1}(y_{t+s}) + \Delta E_t(y_{t+s}) + e_{t,t+s}. \tag{1}$$

The economic tracking portfolio returns are obtained from equation $r_{t-1,t} = \boldsymbol{bR}_{t-1,t}$, where $\boldsymbol{R}_{t-1,t}$ is a column vector of the chosen base asset returns over the period from $t - 1$ to t, and $\boldsymbol{b}$ is a row vector of portfolio weights. The portfolio weights are chosen so that the economic tracking portfolio returns are maximally correlated with innovations in expectations about y_{t+s}, $\Delta E_t(y_{t+s})$. Unexpected returns on the base assets are actual returns minus expected returns. That is, $\tilde{\boldsymbol{R}}_{t-1,t} = R_{t-1,t} - E_{t-1}(R_{t-1,t})$. The key assumption is that unexpected returns on the base assets reflect innovations in expectations about the future macroeconomic variable. Specifically,

$$\Delta E_t(y_{t+s}) = a\boldsymbol{R}_{t-1,t} + \xi_t, \tag{2}$$

where ξ_t is the component of news that is orthogonal to unexpected returns.

It is assumed that expected returns on the base assets in time t are linear functions of $\boldsymbol{Z}_{t-1}$:

$$E_{t-1}(\boldsymbol{R}_{t-1,t}) = \mathrm{d}\boldsymbol{Z}_{t-1}, \tag{3}$$

where $\boldsymbol{Z}_{t-1}$ is a vector of control variables known at time $t - 1$. We define the project equation of lagged expectations of y on the lagged control variables:

$$E_{t-1}(y_{t+s}) = f\boldsymbol{Z}_{t-1} + \mu_{t-1}. \tag{4}$$

Plugging equations (2)–(4) into equation (1) yields:

$$y_{t+s} = b\boldsymbol{R}_{t-1,t} + c\boldsymbol{Z}_{t-1} + \varepsilon_{t,t+s}, \tag{5}$$

where $\varepsilon_{t+s} = \eta_t + \mu_{t-1} + e_{t,t+s}$, $b = a$, and $c = f - ad$. This is a consistent regression equation because all the components of $\varepsilon_{t,t+s}$ are by definition orthogonal to both $\boldsymbol{R}_{t-1,t}$ and $\mathbf{Z}_{t-1}$. The OLS applied to equation (5) produces the economic tracking portfolio returns having unexpected components maximally correlated with ΔE_t (y_{t+s}). Therefore, an economic tracking portfolio is a type of "maximum correlation portfolio" of Breeden *et al.* (1989). It has returns that have the maximum correlation with the target variable of a portfolio consisting of the base assets.

In this study, we estimate equation (5) and examine the properties and the forecasting ability of the resulting economic tracking portfolios. Equation (5) depends only on two assumptions: innovations in returns reflect innovations in expectations about future variables (so that the coefficient vector has non-zero elements in equation (2); and expected asset returns and expected target macroeconomic variables are linear functions of the lagged control variables.

2.2. Constructing the Economic Tracking Portfolios

In this section, we present the method of how to construct the economic tracking portfolios for innovations in expectations of future money growth. The first step is to estimate the following regression model:

$$MON_{t,t+S} = cR_{t-1,t} + \mathrm{d}\boldsymbol{Z}_{t-2,t-1} + \eta_{t,t+s}, \tag{6}$$

where $MON_{t,t+S}$ is the s-month ahead future money growth between t and $t + S$; $\boldsymbol{R}_{t-1,t}$ is the vector of the returns of base assets between $t - 1$ and t in excess of the riskless return; $\boldsymbol{Z}_{t-2,t-1}$ is the vector of the intercept and the control variables between $t - 2$ and $t - 1$; $\eta_{t,t+k}$ represents the random error terms; and c and d are the regression coefficient vectors to be estimated. The implicit assumption in equation (6) is that current asset returns reflect news from s months ahead on future money (or macro liquidity) growth.

After estimating the regression model of equation (6) using monthly data, we compute returns on the tracking portfolio as:

$$TP_{t-1,t} = \hat{c}\boldsymbol{R}_{t-1,t}. \tag{7}$$

That is, returns on the tracking portfolios (TP) are obtained by multiplying the base assets' returns by the estimated value of c from equation (6). The necessary condition for base assets is that they are informative about innovations in expectations of future money growth. The control variables (i.e. lagged $\boldsymbol{Z}_{t-2,t-1}$) should have an ability to predict the returns of base assets. We use zero-investment portfolios for the base assets by subtracting the risk-free rate of returns from each of the base asset returns. Thus, there is no restriction imposed on portfolio weight, c. The estimation of the economic tracking portfolios through equation (6) imposes no particular model of asset prices or equilibrium conditions. The only assumption used in deriving equation (6) is that information on changes in expectations of the future value of an economic variable is reflected in asset returns, and these asset returns are a function of the lagged control variables. This assumption is justified if financial markets are efficient enough to reflect information on changes in expectations about future economic conditions.

The estimation procedure for the tracking portfolios using equation (6) differs from the estimation in the Breeden *et al.* (1989) factor mimicking portfolios. First, the dependent variable of equation (6) is the realized future economic variable, whereas the dependent variable in the estimation of the factor mimicking portfolio is the contemporaneous economic variable. Therefore, the tracking portfolios are designed to capture news about future economic conditions. Second, control variables, which have the predictive ability for asset returns, are used in estimating the tracking portfolios, while they are not used in estimating the factor mimicking portfolio.

2.3. Testing Methodologies for the Pricing Ability of Future Money Growth

In order to examine whether revision in expectations of future money growth is priced in stock returns, we employ two testing methods: the Fama and MacBeth (1973) two-pass methodology and the SDF approach implemented by the GMM estimation.

2.3.1. Fama–MacBeth Method

In the first pass of this method, factor loadings (or betas) for an asset are estimated by intertemporally regressing the asset's returns on the risk factors. That is, for a given asset i,

$$R_{i,t+1} = \alpha_i + \boldsymbol{\beta}_i' \boldsymbol{f}_{t+1} + \varepsilon_{i,t+1}, \tag{8}$$

where $R_{i,t+1}$ is the return on asset i; $\boldsymbol{f}_{t+1}$ is a vector of K common risk factors; $\varepsilon_{i,t+1}$ is the idiosyncratic residual term of asset i; and β_i is a $(\boldsymbol{K} \times 1)$ factor loading vector for asset i. If common factors are relevant to an explanation of the cross-section of average returns, then the factor loadings should be significant and show a systematic pattern across assets.

In the second pass, all test assets' returns in excess of the riskless return are cross-sectionally regressed on their factor loadings estimated in the first pass. That is, for a given time t,

$$r_{i,t} = \boldsymbol{\lambda}_0 + \boldsymbol{\lambda}'\hat{\boldsymbol{\beta}}_i + e_{i,t}, \tag{9}$$

where $r_{i,t}$ is the excess return on asset i; $\hat{\boldsymbol{\beta}}_i$ is the estimated factor loadings vector of asset i; $e_{i,t}$ is the error term; and λ is a $(\boldsymbol{K} \times 1)$ parameter vector of the risk premia to be estimated. In the second-pass cross-sectional regression (CSR), a well-known problem, the so called errors-in-variables problem, arises due to the use of the estimated factor loadings as regressors. To judge the overall fit of each asset pricing model in the CSR, we adopt the cross-sectional R^2 measure used by Jagannathan and Wang (1996) and Lettau and Ludvigson (2001) as a summary statistic. This measure is defined as:

$$R^2 = \frac{\mathrm{Var}(\bar{r}) - \mathrm{Var}(\bar{e})}{\mathrm{Var}(\bar{r})}, \tag{10}$$

where $\mathrm{Var}(\bar{r})$ is the cross-sectional variance of the average returns and $\mathrm{Var}(\bar{e})$ is the cross-sectional variance of the residual average returns.

2.3.2. Stochastic Discount Factor Approach

It is well known that when there is no arbitrage, there exists a positive stochastic discount factor (SDF) (or pricing kernel) m_{t+1} such that:

$$E_t[m_{t+1}\boldsymbol{R}_{t+1}] = \mathbf{1}_{\boldsymbol{n}}, \tag{11}$$

where $\boldsymbol{R}_{t+1}$ is a $(\boldsymbol{n} \times 1)$ vector of gross returns; $\mathbf{1}_{\boldsymbol{n}}$ is a $(\boldsymbol{n} \times 1)$ vector of ones; and n is the number of the test assets. Because all asset pricing models under consideration are linear factor pricing models, the pricing kernel can be represented as a linear combination of those K factors. That is,

$$m_{t+1} = b_0 + \boldsymbol{b}_1'\boldsymbol{f}_{t+1}, \tag{12}$$

where $\boldsymbol{f}_{t+1}$ is a $(\boldsymbol{K} \times 1)$ vector of factors; b_0 is an intercept; and $\boldsymbol{b}_1$ is a $(\boldsymbol{K} \times 1)$ coefficient vector. b_0 and $\boldsymbol{b}_1$ are called the SDF loadings.

When it becomes necessary to simultaneously estimate the tracking portfolios (i.e. estimating coefficients c and d in equation 6) and the coefficients in the SDF (i.e. b_0 and $\boldsymbol{b}_1$ in equation 11), the orthogonality condition of equation (6) is stacked at the moment condition of the asset pricing model of equation (11) such that:

$$g(\theta) = \begin{pmatrix} E[\eta_{t,t+4} \otimes z_t \\ E_t[m_{t+1}\boldsymbol{R}_{t+1} - 1_n] \end{pmatrix} = \begin{pmatrix} \mathbf{0} \\ \mathbf{0} \end{pmatrix}, \tag{13}$$

where $\theta = (b_0,\ \boldsymbol{b}_1,\ c,\ d)$ represents the parameters to be estimated, and $\boldsymbol{z}_t = [\boldsymbol{B}_{t-1,t} : \boldsymbol{Z}_{t-2,t-1}]$ is a vector of the explanatory variables in equation (6). However, when risk factor $\boldsymbol{f}_{t+1}$ is already determined, it is natural to estimate only the coefficients in the SDF, and, therefore, only the moment condition of the asset pricing model of equation (11) is used such that:

$$g(\theta) = (E[m_{t+1}\boldsymbol{R}_{t+1} - \mathbf{1}_{\boldsymbol{n}}]) = (\mathbf{0}), \tag{14}$$

where $\theta = (b_0, \boldsymbol{b_1})$. Parameters θ are chosen by minimizing the quadratic form:

$$J_T = g(\theta)'\mathbf{W}g(\theta), \tag{15}$$

where $\mathbf{W}$ is a weighting matrix that defines the metric used to make g close to zero. Because our competing models already have the determined risk factors, the estimation of the pricing ability of these competing models can be accomplished by Hansen's (1982) GMM method using equation (14). To make a fair comparison, the pricing ability of our alternative model is also estimated in the same way as the competing models.

Two weighting matrices are used to minimize the quadratic equation of equation (15). The first is the asymptotically optimal weighing matrix, which is adopted to compute Hansen's *J*-statistic on the overidentifying restrictions of the models. The second is the Hansen and Jagannathan (1997) weighing matrix, $\mathbf{E}[\mathbf{RR}']^{-1}$, which is the inverse of the second moments of asset returns. Its main advantage is that it is invariant across competing asset pricing models. Therefore, to compare the performance of pricing ability across models, we use this weighting matrix in computing the Hansen and Jagannathan (1997) distance. The Hansen–Jagannathan distance can be interpreted as the maximum pricing error for the set of assets mispriced by the model (Campbell and Cochrane, 2000).

According to Cochrane (1996), the risk premia, λ, can be estimated using the SDF approach as follows:

$$\lambda = -r_f \mathrm{Cov}(\boldsymbol{f}, \boldsymbol{f}')\boldsymbol{b}_1, \tag{16}$$

where r_f is the riskless return; $\boldsymbol{f}$ is a $(\boldsymbol{K} \times 1)$ vector of the factors; and $\boldsymbol{b_1}$ is a $(\boldsymbol{K} \times 1)$ coefficient vector in the pricing kernel of equation (12).

3. Data

3.1. Definition of Money Growth

We use narrow money (M1) to measure money growth, because M1 can be immediately converted into currency or used for cashless payment and has an immediate impact on the status of money market liquidity. Narrow money (M1) has three components: (i) currency with the public; (ii) demand deposits (other than banker's deposits); and (iii) transferable deposits, which can be immediately withdrawn into currency without any difficulty. For money data, the seasonally adjusted money data are taken from Bank of Korea.

3.2. Base Assets and Control Variables

To construct the tracking portfolios that reflect innovations related to future money growth, we need to choose base assets that are informative about changes in expectations regarding future money growth. In this study, we choose 10 industry-sorted stock portfolios and six equity portfolios with different book to market and firm size characteristics. All stocks in KSE are used to form the base assets.

The construction of the tracking portfolios also needs the control variables to capture the unexpected component of base assets' return. Control variables should have the ability to predict future stock returns. Therefore, we include the 1-month monetary stabilization bond yield (*RF*), the default spread (*DEF*), and the term spread (*TERM*) as the control variables. *DEF* is the difference between the yield of AA corporate bonds and the government bond yields, and *TERM* is the difference between the yields of a 5-year treasury bonds yields and a 1-year Monetary Stabilization Bond issued by the Bank of Korea. All the bond yields data are obtained from the database of the Bank of Korea.

For test assets, we use 25 size and book-to-market sorted portfolios, as in Fama and French (1993), because these portfolios are one of the most commonly used test assets in the literature. The test period is from March 1995 to December 2008.

4. Empirical Results

4.1. Predictability of the Base Assets for Future Money Growth

One necessary condition for selecting base assets is that base assets should reflect innovations of future expected money growth. It is important, therefore, to examine whether returns on the chosen base assets are actually able to predict future money growth. To do so, we regress future money growth rates from t to $t + S$ on the intercept and returns of the 16 base assets and the control variables, as in equation (6).

To determine a reasonable value of S that provides reliable and stable regression coefficients on the base asset returns, we estimate the regression model of equation (6) for $S = 1, 2, 3, 4, 5, 6, 9$ and 12 months. Table 1 reports the estimation results of the regression coefficients for each value of S. Table 1 also reports the Wald test statistics for the null that the coefficients of the base assets' returns are jointly zero (i.e. H_0: $c = 0$).[1] The asymptotic p-values of the Wald test is <0.001 when $S = 1$ and 3 months. The Wald statistic is extremely high when $S = 3$ months. This indicates that the null hypothesis of no forecasting ability of the base assets for innovations in future money growth is strongly rejected. Therefore, we use 3-month future money growth rates to estimate returns on the tracking portfolio. For the robustness check, we have tested longer horizons, such as $S = 6$, 9, and 12 months, However, the overall results with $S = 6$, 9, and 12 months do not reject the null

[1]The t-statistics in Table 1 are corrected for serial correlation up to three lags and 'White's (1980) heteroskedasticity using the Newey and West (1987) estimator.

Table 1 Predictability of future money growth by the base assets

The table reports the forecasting regression results for the following regression specification: $MON_{t,t+S} = a + c\boldsymbol{R}_{t-1,t} + \mathrm{d}\boldsymbol{Z}_{t-2,t-1} + \eta_{t,t+S}$, where $MON_{t,t+S}$ is the money growth rate over the next $t + S$ month from t. $\boldsymbol{R}_{t-1,t}$ is the value-weighted return on the base assets [market return minus risk free return (RMRF), 10 equity industry portfolios and six equity portfolios with different book to market (B/M) and size (MV) characteristics]. The returns of the 16 portfolios are in excess of the riskless return. The 10 equity industries portfolios are constructed using the FnGuide Industry Classification Standard. In the six equity portfolios based on B/M and MV, S MV stands for small MV, whereas B MV stands for big MV. L B/M, M B/M, and H B/M denote low, medium, and high B/M, respectively. $\boldsymbol{Z}_{t-2,t-1}$ is the lagged control variables containing a constant, the yield spread of 5-year Treasury government bonds minus the yield of 1 year Monetary stabilization bond issued by the Bank of Korea (*TERM*), the default premium calculated as the 3-year yield on AA corporate bond minus 3-year treasury government bonds (*DEF*) and the risk free rate (*RF*). The *t*-statistics are reported in parentheses and are corrected for serial correlation up to three lags and White's (1980) heteroskedasticity using the Newey and West (1987) estimator. The Wald test statistics and their corresponding *p*-values are reported to test the null hypothesis that the coefficients of the base assets are jointly zero. The sample period is from March 1995 to December 2008.

S	1	2	3	4	5	6	9	12
Base asset								
RMRF	0.01 (0.08)	0.25 (0.91)	0.23 (1.04)	0.02 (0.07)	−0.20 (−0.51)	−0.21 (−0.44)	−0.76 (−1.14)	−0.64 (−0.78)
Oil and gas	−0.02 (−0.99)	0.00 (−0.15)	0.02 (0.57)	0.00 (0.03)	0.06 (1.54)	0.04 (0.84)	0.07 (0.91)	0.04 (0.44)
Basic materials	−0.02 (−0.44)	−0.12 (−1.85)	−0.10 (−1.09)	0.06 (0.59)	0.13 (1.28)	0.04 (0.38)	−0.06 (−0.37)	−0.03 (−0.14)
Industrials	−0.06 (−0.89)	−0.08 (−0.84)	−0.12 (−1.27)	−0.22 (−1.25)	−0.40 (−1.57)	−0.27 (−0.96)	−0.04 (−0.15)	0.35 (0.81)
Consumer goods	−0.04 (−0.98)	−0.05 (−0.61)	0.01 (0.10)	0.03 (0.22)	0.15 (1.10)	0.16 (1.19)	0.04 (0.21)	−0.04 (−0.18)
Consumer services	−0.02 (−0.54)	0.09 (1.42)	0.13 (1.62)	0.07 (0.65)	−0.02 (−0.21)	−0.15 (−1.14)	−0.27 (−2.02)	−0.45 (−2.66)
Health care	0.00 (−0.01)	−0.09 (−1.72)	−0.11 (−1.66)	−0.16 (−1.57)	−0.14 (−1.16)	−0.12 (−1.01)	0.06 (0.42)	0.11 (0.48)
Financials	−0.02 (−0.59)	−0.04 (−0.71)	0.01 (0.10)	0.04 (0.62)	0.08 (0.91)	0.04 (0.37)	0.17 (1.16)	0.12 (0.70)
Technology	−0.02 (−0.52)	−0.03 (−0.41)	−0.08 (−1.49)	−0.09 (−1.27)	−0.10 (−0.86)	−0.15 (−1.18)	0.19 (1.16)	0.35 (1.80)
Telecom	0.00 (−0.15)	−0.05 (−0.93)	0.02 (0.49)	0.06 (1.10)	0.02 (0.35)	0.04 (0.46)	0.18 (1.45)	0.23 (1.42)
Utilities	−0.06 (−2.16)	−0.02 (−0.65)	0.02 (0.35)	0.08 (0.91)	0.13 (1.74)	0.12 (1.82)	−0.03 (−0.38)	−0.11 (−0.89)
S MV, L B/M	0.03 (0.61)	0.11 (1.49)	0.00 (0.00)	0.12 (1.06)	0.28 (2.02)	0.38 (2.28)	0.04 (0.21)	−0.03 (−0.13)
S MV, M B/M	−0.02 (−0.48)	−0.05 (−0.39)	0.00 (0.03)	−0.16 (−0.92)	−0.46 (−2.26)	−0.49 (−2.14)	−0.02 (−0.08)	0.30 (0.99)
S MV, H B/M	−0.04 (−0.82)	−0.02 (−0.31)	0.13 (1.34)	0.11 (1.24)	−0.04 (−0.32)	−0.07 (−0.49)	−0.01 (−0.09)	−0.08 (−0.47)
B MV, L B/M	0.12 (1.48)	−0.13 (−0.93)	0.07 (0.46)	0.25 (0.89)	0.29 (0.71)	0.15 (0.34)	−0.23 (−0.69)	−0.56 (−1.03)

Table 1 (*Continued*)

S	1	2	3	4	5	6	9	12
B MV, M B/M	0.08 (0.7)	0.27 (2.75)	0.02 (0.12)	−0.11 (−0.47)	0.10 (0.3)	0.32 (0.84)	0.07 (0.19)	−0.29 (−0.73)
B MV,H B/M	0.05 (0.65)	−0.01 (−0.11)	−0.08 (−0.54)	0.04 (0.24)	0.17 (0.7)	0.10 (0.37)	0.34 (1.21)	0.348 (0.98)
Control variables								
RF	1.60 (1.82)	3.94 (2.74)	4.67 (2.29)	4.44 (1.61)	6.82 (1.80)	9.89 (2.05)	16.11 (3.35)	23.33 (3.39)
DEF	−0.44 (−1.25)	−0.31 (−0.57)	0.48 (1.18)	1.25 (2.54)	1.10 (1.14)	1.32 (1.21)	2.91 (2.77)	2.87 (1.78)
TERM	0.90 (2.08)	2.08 (2.41)	2.02 (2.12)	1.21 (1.49)	1.52 (1.68)	2.65 (2.27)	3.45 (1.93)	3.44 (1.5)
Constant	0.00 (0.11)	−0.01 (−1.04)	−0.01 (−1.01)	−0.01 (−0.35)	−0.01 (−0.39)	−0.02 (−0.9)	−0.06 (−2.32)	−0.09 (−2.28)
R^2	0.20	0.23	0.30	0.26	0.28	0.29	0.44	0.47
Adjusted R^2	0.09	0.12	0.19	0.16	0.17	0.18	0.35	0.38
Wald	45.02	22.59	65.30	31.09	30.70	21.13	22.15	19.36
p-value	0.00	0.16	0.00	0.02	0.02	0.22	0.18	0.31

hypothesis of no forecasting ability of the base assets. The above results indicate that the current stock price reflects innovations in 3-month ahead money growth. Therefore, the 3-month ahead future money growth factor is used in the present paper.

After estimating the regression coefficients of equation (6), returns on the tracking portfolio are obtained by multiplying the estimated regression coefficients by returns on the base assets, as in equation (7). We regard these returns as a risk factor associated with innovations in the expectation of future money growth and denote it as *MG*. To examine the relation between average returns and the factor loadings on *MG*, β_{MG}, every month we assign all firms into 1 of 10 decile portfolios according to the magnitude of their money growth betas (β_{MG}). *MG* betas (β_{MG}) are computed every month by using the previous 36 monthly return observations available up to estimation month *t*.

Table 2 shows the average values of the portfolio characteristics of each of 10 decile portfolios sorted by *MG* betas. The average return on the smallest *MG* beta portfolio is 1.29%, and that on the largest *MG* beta portfolio is 2.64%. The difference in average return between the largest and smallest *MG* beta portfolios is 1.35% (with a *t*-statistic of 2.89). The average market betas of 10 decile *MG* beta portfolios monotonically increase across *MG* beta portfolios. The difference in average market betas between the largest and smallest *MG* beta portfolios is 1.19% (with a *t*-statistic of 1.38). Table 2 also shows the average size and average book to market ratio of the 10 decile *MG* beta portfolios. However, the average size and average BTM do not show any systemic pattern across the *MG* beta portfolios.

Table 3 reports the summary statistics of the five risk factors considered: excess market returns (*MKT*), Fama and French factors related to size and book to market (*SMB* and *HML*), 1-year momentum factor (*MOM*) and revision in the expectation

Table 2 Characteristics of 10 decile portfolios sorted on money growth (*MG*) betas

Each month all sample firms are assigned into one of 10 decile portfolios according to the magnitude of their money growth (*MG*) betas. *MG* betas (β_{MG}) are computed every month by using the previous 36 monthly return observations available up to the estimation month. Firm size is in billion won. "BM" is the book-to-market ratio of common equity. "P10–P1" indicates the difference in the average between Portfolio 10 and Portfolio 1. The sample period is from March 1995 to December 2008.

	MG decile portfolios											
	1	2	3	4	5	6	7	8	9	10	P10–P1	*t*-value
Average return	1.29	2.25	2.37	2.63	2.86	2.77	3.14	2.92	2.60	2.64	1.35	2.89
Standard deviation	21.1	21.7	20.5	22.6	21.2	25.4	25.1	28.4	28.3	32.7		
Market beta	−0.08	0.68	0.70	0.77	0.83	0.87	0.95	1.01	1.10	1.11	1.19	1.38
Firm size	361	626	579	536	533	708	795	714	618	422	61.0	
Average BM	1.74	2.14	2.21	2.33	2.49	2.48	2.26	2.33	2.20	1.72	−0.02	

Table 3 Descriptive statistics

The table reports the mean and standard deviation of the risk factors and the correlation coefficients between the factors. *MKT* is the market return, *SMB* and *HML* are the factors related to firm size and book-to-market, respectively, *MOM* is the momentum factor, and *MG* is the factor reflecting innovations to future money growth, which is obtained from Lamont's (2001) economic tracking portfolio approach. The sample period is from March 1995 to December 2008.

	MKT	*SMB*	*HML*	*MOM*	*MG*
Mean	0.406	1.111	1.383	−1.509	0.085
Standard deviation	9.760	6.793	5.133	14.979	1.779
Correlation coefficient					
MKT	1.000	−0.187	−0.048	−0.056	0.521
SMB		1.000	0.278	−0.510	0.348
HML			1.000	−0.556	0.302
MOM				1.000	−0.481
MG					1.000

of future *MG* factor. The correlation coefficients of *MG* with *MKT*, *SMB*, *HML*, and *MOM* are 0.521, 0.348, 0.302 and −0.481 respectively.[2]

4.2. Two-Pass Testing Results

4.2.1. Pattern of the Factor Loadings on the Future Money Growth

It is widely accepted in the literature that firm size and book-to-market are important forces in explaining stock returns. If a given factor is a determinant of average returns, then the loading associated with that factor is used for a systematic pattern across firm sizes and book-to-market ratios. In this context, we examine whether there is a systematic pattern in the loading with the factor associated with innovations in future *MG* across firm sizes and book-to-market ratios. As described in Section 2, the returns of the *TP* are estimated through the multiplication of the base assets' returns and the coefficient c estimated in the regression model of equation (7). That is, $TP_{t-1,t} = c\boldsymbol{R}_{t-1,t}$. These tracking portfolio returns are used as a proxy for innovations in future money growth. Note that cross-sectional regression tests in this section are performed using monthly returns.

Table 4 shows the estimation results of the time-series univariate regression model of each of the 25 size and book to market-sorted portfolios on each of the five factors. The factor loadings associated with revisions in the expectation of future money growth (β_{MG}) are estimated and all significantly estimated. More importantly, the estimated factor loadings show a systematic pattern across both firm size and book-to-market. That is, β_{MG} monotonically decreases with firm size within each book-to-market quintile and increases with book-to-market within each

[2]Chae and Eom (2009), Kim (2010) and Kim *et al.* (2011b) mention the negative momentum profits in the Korean stock market.

Table 4 Factor loading estimates of each of the risk factors

This table reports the estimates results of the time-series univariate regression of returns on the 25 size and book-to-market sorted portfolios on each of the five risk factors: excess market returns (*MKT*), the Fama-French factors related to size and book-to-market (*SMB*, *HML*), momentum factor (*MOM*), revision in the expectation of future money growth (*MG*). The *t*-statistics are corrected for autocorrelation and heteroskedasticity using the Newey and West (1987) estimator with three lags, are reported. The sample period is from March 1995 to June 2008.

	Low	2	3	4	High	Low	2	3	4	High
	β_{MKT}					$t(\beta_{MKT})$				
Small	0.81	0.82	0.76	0.84	0.85	7.27	6.51	8.98	10.16	6.92
2	0.90	0.92	0.89	0.81	0.93	9.40	7.68	9.97	10.19	9.46
3	0.78	0.95	0.90	0.90	0.96	10.92	9.67	13.60	13.74	10.23
4	0.94	0.90	0.96	0.91	0.94	14.50	12.06	13.76	13.95	11.92
Large	0.97	1.01	1.02	1.03	1.06	16.82	13.46	26.69	21.25	16.18
	β_{SMB}					$t(\beta_{SMB})$				
Small	1.21	1.07	0.96	0.97	1.23	8.69	7.24	7.68	4.79	3.89
2	0.46	0.61	0.51	0.78	0.86	4.44	3.99	3.29	3.00	2.78
3	0.62	0.41	0.27	0.34	0.45	2.41	1.94	1.63	1.87	1.86
4	0.16	0.08	−0.05	0.02	0.07	0.95	0.56	−0.36	0.09	0.34
Large	−0.21	−0.31	−0.33	−0.34	−0.29	−1.47	−2.06	−2.21	−1.89	−1.36
	β_{HML}					$t(\beta_{HML})$				
Small	−0.01	0.14	0.65	0.78	1.43	−0.03	0.29	1.72	1.50	2.36
2	−0.18	0.04	0.36	0.85	1.07	−0.48	0.07	0.83	1.81	1.82
3	−0.02	0.11	0.13	0.55	1.00	−0.04	0.22	0.35	1.62	2.48
4	−0.20	−0.14	0.01	0.70	0.76	−0.49	−0.48	0.03	2.36	2.38
Large	−0.37	−0.21	0.12	0.20	0.52	−1.09	−0.60	0.41	0.69	1.54
	β_{MOM}					$t(\beta_{MOM})$				
Small	−0.35	−0.29	−0.32	−0.39	−0.62	−4.89	−5.42	−7.57	−5.98	−9.25
2	−0.20	−0.19	−0.16	−0.40	−0.48	−2.55	−2.82	−2.34	−6.15	−6.08
3	−0.13	−0.20	−0.16	−0.19	−0.33	−2.70	−2.22	−2.97	−4.09	−6.24
4	−0.14	−0.06	−0.06	−0.21	−0.19	−2.86	−1.40	−1.46	−4.03	−4.20
Large	−0.04	0.00	−0.05	−0.09	−0.13	−0.89	0.06	−1.38	−2.19	−2.67
	β_{MG}					$t(\beta_{MG})$				
Small	4.38	4.40	4.39	4.80	5.73	6.63	6.62	7.86	7.53	5.01
2	3.66	3.68	3.59	4.47	5.02	4.82	6.33	6.71	6.26	5.11
3	2.79	3.86	3.35	3.64	4.21	6.66	6.83	7.00	7.62	6.23
4	3.03	2.80	3.01	3.68	3.42	5.57	4.03	4.17	6.65	6.59
Large	2.57	2.66	2.95	2.75	3.07	4.86	3.80	5.03	5.19	5.58

firm size quintile. This is indirect evidence that the future money growth factor is related to both firm size and book-to-market. This is an interesting result, because we find that each of the Fama and French factors is related only to its own corresponding characteristic. That is, *SMB* is related only to firm size, and *HML* is related only to book-to-market.[3]

One necessary condition for a factor loading to have satisfactory explanatory power for cross-sectional variations in average returns is that it should have a sufficient cross-sectional spread in factor loading. In this sense, the future money growth factor satisfies this necessary condition, because the magnitude of the cross-sectional spread in β_{MG} is greater than that in the other factor loadings under consideration. For example, the cross-sectional spread in β_{MG} is between 2.57 and 5.73. However, the cross-sectional spreads in β_{SMB} and β_{HML} are only between −0.21 and 1.23 and between −0.37 and 1.43, respectively. Moreover, the smallest and largest values of β_{MG} occur at the lower-left and upper-right corners of the table, where the smallest and largest average returns occur, respectively. However, the smallest and largest values of β_{SMB} do not occur at these corners.

4.2.2. Results of Cross-Sectional Regression Tests

In the time-series estimation, we have preliminarily observed a positive cross-sectional association between the factor loadings on the future money growth factor (β_{MG}) and average stock returns. To formally examine whether the risk associated with innovations in future money growth is priced, it is necessary to perform cross-sectional tests.

Table 5 reports the CSR estimation results within the Fama and MacBeth (1973) two-pass methodology framework of the capital asset pricing model (Model 1), the Fama and French three-factor model (Model 2), the four-factor model including Fama and French's three factors plus the momentum factor (Model 3), the one-factor model including *MG* only (Model 4), the two-factor model include the market factor and *MG* (Model 5), another four-factor model including the Fama and French three factors plus *MG* (Model 6), and the five-factor model including the Fama and French three factors, the momentum factor, and *MG* (Model 7). Test portfolios are 25 size and book-to-market sorted portfolios, as in Fama and French (1993). Beta variables are the whole-period betas (in Panel A) using the whole sample return observations and the rolling-over predictive betas (in Panel B) using the previous 36-month returns available up to the CSR estimate month by rolling over one month by month.

Panel A of Table 5 shows that when *MG* is alone in the model (in Model 4), *MG* has a significant explanatory power for average stock returns. The risk premium estimate of *MG* ($\hat{\gamma}_{MG}$) is 0.83% per month (with *t*-statistic of 2.81). The adjusted R^2 of Model 4 is 0.59. When *MG* is together with the market factor (Model 5), *MG* still has a significant explanatory power; its risk premium estimate

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[3]More specifically, as designed, the factor loadings on *SMB* (β_{SMB}) show a monotonic decreasing pattern across firm size but almost no pattern across book-to-market. Meanwhile, the factor loadings on *HML* (β_{HML}) show a monotonic increasing pattern across book-to-market but almost no pattern across firm size.

Table 5 Cross-sectional regression estimation results

The table reports the estimation results (in percent per month) of the month-by-month cross-sectional regressions: $r_{i,t} = \lambda_0 + \lambda' \hat{\beta}_i + e_{i,t}$, where $r_{i,t}$ is the return of portfolio i in excess of the riskless return, and $\hat{\beta}$ is the factor loadings estimated in the first-pass multiple time-series regression model by using monthly returns over the whole sample period (the whole-period beta) or by using monthly returns of the past 36 months available up to the CSR estimation month (the rolling-over predictive beta). The test portfolios are 25 size and BM portfolios formed by Fama and French (1993). *MKT* is the market return, *SMB* and *HML* are Fama and French's (1993) factors related to firm size and book-to-market, respectively, *MOM* is the momentum factor, and *MG* is the factor reflecting innovations to future money growth. Numbers in parentheses indicate t-statistic. The adjusted R^2 is computed from Jagannathan and Wang (1996). The sample period is from March 1995 to December 2008.

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Panel A: Using the whole–period betas							
Intercept	3.99 (1.40)	−2.13 (−1.22)	−3.78 (−2.17)	−2.17 (−1.87)	−4.17 (−1.68)	−2.04 (−1.19)	−4.55 (−2.47)
β_{MKT}	−3.43 (−1.20)	2.19 (1.15)	3.81 (1.98)		4.45 (1.71)	2.18 (1.14)	4.79 (2.36)
β_{SMB}		0.97 (1.86)	1.05 (2.00)			0.95 (1.81)	1.02 (1.94)
β_{HML}		1.21 (2.94)	1.23 (3.00)			1.16 (2.81)	1.10 (2.67)
β_{MOM}			−0.85 (−0.52)				−0.45 (−0.28)
β_{MG}				0.83 (2.81)	1.09 (3.00)	0.62 (1.71)	1.19 (3.14)
Adjusted R^2	0.09	0.65	0.68	0.59	0.61	0.65	0.72
Panel B: Using the rolling–over predictive betas							
Intercept	1.66 (0.91)	0.55 (0.48)	−0.03 (−0.02)	−0.52 (−0.44)	1.56 (0.94)	0.14 (0.12)	−0.19 (−0.16)
β_{MKT}	0.14 (0.07)	0.53 (0.40)	1.14 (0.81)		−0.06 (−0.04)	1.17 (0.88)	1.41 (1.03)
β_{SMB}		0.90 (1.47)	0.98 (1.60)			1.00 (1.61)	1.00 (1.61)
β_{HML}		1.41 (3.03)	1.53 (3.25)			1.44 (3.08)	1.51 (3.20)
β_{MOM}			−0.17 (−0.11)				−0.40 (−0.25)
β_{MG}				0.68 (2.54)	0.48 (1.69)	0.47 (1.93)	0.50 (2.16)
Adjusted R^2	0.09	0.63	0.72	0.53	0.50	0.70	0.75

is 1.09% per month (with t-statistic of 3.00). The adjusted R^2 of this model is 0.61. By adding the market factor, the adjusted R^2 is increased only by 0.02. Even when the Fama and French three factors are added into *MG*, the significance of *MG* is maintained. That is, when the Fama and French three factors and *MG* (Model 6) are in the model, the risk premium estimate of *MG* is 0.62% per month (with t-statistic of 1.71). When all five factors (Model 7) are in the model, the risk premium estimate of *MG* is 1.19% per month (with t-statistic of 3.14). The adjusted R^2 in this case is 0.75. *MG* has a significant explanatory power for average stock returns in any model considered. When *MG* is in the model, *SMB* and *HML* are also significantly priced, whereas the momentum factor is not. These results indicate that *MG* has a marginal contribution in explaining average stocks in Korea even after controlling for the well-know pricing factors such as *SMB* and *HML* and that it does not subsume the pricing information contained in other factors such as *SMB* and *HML*.

Panel B of Table 5 also reports the CSR estimation results of the above-mentioned seven models by using the 36-month predictive rolling-over betas. The results are similar to the results when the whole-sample betas are used. The estimates of the risk premium of *MG* in Models 4–7 are 0.68% per month (with t-statistic of 2.54), 0.48% per month (with t-statistic of 1.69), 0.47% per month (with t-statistic of 1.93), and 0.50% per month (with t-statistic of 2.16), respectively.

4.3. Generalized Method of Moments Estimation Results

Along with the Fama–MacBeth CSR tests, we evaluate the performance of *MG* using the SDF approach implemented through the GMM estimation, which is robust for nonstandard behavior of error terms, such as heteroskedasticity and serial correlation. Table 6 reports the GMM estimation results using the optimal weighting matrix, which are generally consistent with the CSR results. The GMM estimation results for the Fama and French three-factor model (Model 2) show that *SMB* and *HML* are significantly priced. Their risk premia are statistically significant, and the p-values of the Wald (b) tests are less than a 1% significance level. Note that the Wald (b) test examines whether the coefficients in the pricing kernel, b, or the SDF loadings are jointly zero. Rejecting the null hypothesis of $b = 0$ implies that the factors jointly have important implications of the SDF and have marginal explanatory power for pricing the test portfolios.

Table 6 also shows that when *MG* is alone in the model (in Model 4), *MG* also has a significant explanatory power for average stock returns. The risk premium estimate of *MG* is 0.90% per month (with t-statistic of 2.53). When *MG* is with the market factor (Model 5), *MG* has still a significant explanatory power; its risk premium estimate is 0.92% per month (with t-statistic of 2.58). When the Fama and French three factors are added into *MG*, the significance of *MG* is weakened. That is, when the Fama and French three factors and *MG* (Model 6) are in the model, the risk premium estimate of *MG* is insignificant; it is 0.19% per month (with a t-statistic of 0.50). When all five factors (Model 7) are in the model, the risk

Table 6 Generalized method of moments (GMM) estimation results

The table reports the GMM estimation results (in percent per month) of the competing models by using 25 size and book-to-market portfolios formed by Fama and French (1993). *MKT* is the market return in excess of the riskless rate of return, *SMB* and *HML* are Fama and French's (1993) factor related to firm size and book-to-market, respectively, *MOM* is the momentum factor, and *MG* is the factor reflecting innovations related to future money growth. The HJ-distance is the Hansen and Jagannathan (1997) distance measure, and its *p*-value is obtained from 10 000 simulations. The Wald (*b*) test is joint significance test of the factor loadings in the pricing kernel. The *J*-test is Hansen's (1982) test on the overidentifying restrictions of the model. The test statistics for Wald (*b*) and *J* test are computed through the GMM estimation that uses the optimal weighting matrix. The sample period is from March 1995 to December 2008.

Factor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Panel A: Risk premium estimates							
MKT	−2.52 (−1.31)	0.06 (0.03)	2.51 (1.49)		2.75 (1.49)	−0.26 (−0.13)	4.25 (2.21)
SMB		1.27 (2.35)	1.40 (2.75)			1.43 (2.57)	1.47 (2.8)
HML		1.61 (3.36)	1.03 (2.52)			1.72 (3.35)	1.06 (2.48)
MOM			1.38 (1.17)				1.10 (0.91)
MG				0.90 (2.53)	0.92 (2.28)	0.19 (0.50)	1.02 (2.52)
Panel B: Test statistics							
J-test	64.78 (0.000)	53.82 (0.000)	46.67 (0.001)	47.37 (0.002)	45.61 (0.002)	51.14 (0.000)	39.52 (0.004)
Wald (*b*)	1.71 (0.191)	13.53 (0.004)	21.10 (0.000)	6.40 (0.011)	5.85 (0.054)	13.87 (0.008)	20.10 (0.001)
HJ distance	0.7626 (0.0000)	0.6875 (0.000)	0.6612 (0.0005)	0.7323 (0.0000)	0.7322 (0.0000)	0.6849 (0.0000)	0.6610 (0.0003)

premium estimate of MG is 1.02% per month (with t-statistic of 2.52). Overall, the GMM results are similar to those of the CSR tests, except Model 6.

To compare the performance of the asset pricing models, we compute the Hansen–Jagannathan distance, which translates into the maximum pricing error generated by the model. The Hansen–Jagannathan distance test for the null hypothesis that the squared pricing errors are statistically different from zero rejects all models, implying that none of the models considered correctly price the test assets. The p-value for the null hypothesis is computed based on Kan and Robotti (2009).

4.4. Relations of Future Money Growth to Other Macroeconomic Variables

News related to the future money growth could affect other real macroeconomic variables, such as *GDP*, industrial production, and inflation, and in the opposite direction news related to these macroeconomic variables could also affect money growth. In other words, one macroeconomic variable has a feedback effect on the other variables. In this sense, the money growth factor, MG, might contain information on the pricing ability of the other macroeconomic factors. It would be necessary, therefore, to examine the pricing ability of MG after controlling for other macroeconomic factors. In view of Chen *et al.* (1986) and Vassalou (2003), we first consider real macroeconomic variables such as *GDP*, industrial production, anticipated inflation, and unanticipated inflation as the other macroeconomic variables.

To examine the pricing effect of the future money growth after controlling for the real macroeconomic factors, we construct the orthogonalized macroeconomic factors and then estimate the CSR model of equation (9) by using the factor loadings on these orthogonalized factors. To do so, we first estimate the following vector autoregressive process with order of three, VAR(3),

$$\boldsymbol{y}_t = \delta + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \Phi_3 y_{t-3} + e_t, \qquad (17)$$

where $\boldsymbol{y}_t$ is an $(\mathbf{5} \times 1)$ column vector of 3-month ahead future growth rates of money supply M1, *GDP*, industrial production (*IP*), anticipated inflation (INF_A), and unanticipated inflation (INF_U). The anticipated and unanticipated inflation rates are obtained by using the Fama and Gibbons (1984) method. Then, we regress the sum of the intercept and the residuals from equation (17) on returns of the base assets and the control variables and obtain the economic tracking portfolios of the five macroeconomic variables, as described in Section 2.2. They are the orthogonalized macroeconomic factors and denote $MG^{\perp}$, $GDP^{\perp}$, $IP^{\perp}$, $INF_A^{\perp}$, and $INF_U^{\perp}$, respectively. Thus, $MG^{\perp}$ is the future money growth factor capturing news about remaining future money growth after excluding the other four real macroeconomic components.[4]

[4]To obtain the orthogonalized MG factor, we also estimate the time-series regression of the 3-month ahead money growth rates on the 3-month ahead growth rates of the other four macroeconomic variables and use the intercept and the residuals. The results are qualitatively similar to those obtained from using the VAR(3).

Table 7 presents the CSR estimation results when the factor loading on $MG^{\perp}$, $\beta_{MG^{\perp}}$, is used instead of the factor loading on *MG*, β_{MG}. No matter whether $\beta_{MG^{\perp}}$ is alone in the model or is together with the other factors in the model, the gamma estimates on $\beta_{MG^{\perp}}$ are all significant. For example, when $\beta_{MG^{\perp}}$ is included in the Fama–French three-factor model, the gamma estimate on $\beta_{MG^{\perp}}$ is 0.53, with a *t*-statistic of 3.60. Their statistical significance is overall stronger than when the unorthogonalized β_{MG} is used. When the other four orthogonalized macroeconomic factors are added into the four-factor model (*MKT*, *SMB*, *HML*, and *MOM*), the gamma estimate on $\beta_{MG^{\perp}}$ is still maintained. It is 0.34%, with a *t*-statistic of 2.10. Table 7 also reports the CSR estimation results when the factor loadings on all five unorthogonalized macroeconomic factors are included in the model. The gamma estimate on β_{MG} is still significant in this case. It is 0.98%, with a *t*-statistic of 2.63. Interestingly, only *MG* is significant in explaining average stock returns, while the other real macroeconomic factors are statistically insignificant. Overall, *MG* has a significant explanatory power for average stock returns even after controlling for other real macroeconomic factors.

Kim *et al.* (2011a,b) report that the Fama–French five-factor model containing the Fama–French three equity factors plus term spread (*TERM*) and default spread (*DEF*) performs most satisfactorily in explaining the intertemporal and cross-sectional behavior of stock returns in Korea among the asset pricing models most frequently-mentioned in the literature.[5] They conclude that the two bond factor portfolios, *TERM* and *DEF*, play a significant role in explaining stock returns in Korea. Their results indicate that the addition of the two bond portfolios significantly improves the pricing ability of the Fama–French three-factor model. Because our results also show that *MG* makes a significant marginal contribution to the pricing ability of the Fama–French three factors, *TERM* and *DEF* might be the most plausible candidates behind an economic risk to which *MG* is related. Furthermore, bond markets are more directly affected by changes in money supply than equity markets, the natural candidates to which *MG* is related might be bond market factors. Therefore, we examine the relation between *MG* and *TERM/DEF*. In time-series regression of *DEF* (or *TERM*) on lagged *MG*, we find that the coefficient estimates on lagged *MG* are significantly negative up to the lag of 3 months and are insignificantly negative afterwards. This indicates that current news to future money growth decreases default spread and it has an impact for at least the next 3 months. When the dependent variable is *TERM*, the coefficient estimates on lagged *MG* are significantly positive up to the lag of 2 months and are insignificantly positive afterwards. This indicates that current news to future money growth increases term spread and it has an impact for at least up next 2 months. Because an increase in money supply tends to decrease interest rates, this positive relation may indicate that an increase in future money growth makes short-term interest rates more

[5]Suh and Hong (2011) use the Fama-French five-factor model to measure mutual fund performance in Korea. Hahn and Lee (2006) report that changes in default spread and changes in term spread are related to *SMB* and *HML*.

Table 7 Pricing ability of future money growth after controlling for real macroeconomic factors

This table reports the month-by-month cross-sectional regression estimation results of portfolio excess returns on the whole-period beta estimates of the future money growth after controlling for Fama and French (1993) three-factors and real macroeconomic variables. The test portfolios are 25 size and BM portfolios formed by Fama and French (1993). *MKT* is the market return, *SMB* and *HML* are Fama and French (1993) factors related to firm size and book-to-market, respectively, and *MOM* is the momentum factor. *MG, GDP*, *IP*, INF_A, and INF_U are the factors reflecting innovations to future growth of money supply M1, *GDP*, industrial production (*IP*), anticipated inflation (INF_A), and unanticipated information (INF_U), respectively. The anticipated and unanticipated inflation rates are obtained by using the Fama and Gibbons (1984) method. *MG*, *GDP*, *IP*, INF_A, and INF_U are the unorthogonalized factors obtained from the economic tracing portfolio approach in which the 3-month ahead future growth rates of each macroeconomic variable are the left-hand side variable in equation (6). $MG^{\perp}, GDP^{\perp}, IP^{\perp}, INF_A^{\perp}$, and $INF_U^{\perp}$ are the orthogonalized factors obtained from the economic tracing portfolio approach in which the sum of the intercept and the residuals of each variable generated from the following VAR(3) model are the left-hand side variable in equation (6). The VAR(3) model is described as $\boldsymbol{y}_t = \delta + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \Phi_3 y_{t-3} + e_t$, where $\boldsymbol{y}_t$ is an $(\mathbf{5} \times 1)$ column vector of 3-month ahead future growth rates of money supply M1, *GDP*, *IP*, INF_A, and INF_U. Numbers in parentheses indicate *t*-statistic. The sample period is from March 1995 to December 2008.

Explanatory variable	Model 4′	Model 5′	Model 6′	Model 7′	Model 8	Explanatory variable	Model 9
Intercept	−3.46 (−2.52)	−5.51 (−2.56)	−2.54 (−1.43)	−3.15 (−1.98)	−6.10 (−3.22)	Intercept	−2.93 (−1.74)
β_{MKT}		5.75 (2.39)	2.66 (1.48)	3.25 (1.95)	7.26 (3.27)	β_{MKT}	3.31 (1.66)
β_{SMB}			1.02 (1.89)	1.04 (1.9)	1.05 (1.93)	β_{SMB}	1.01 (1.86)
β_{HML}			1.25 (3.05)	1.26 (3.06)	1.24 (2.99)	β_{HML}	1.10 (2.59)
β_{MOM}				−2.10 (−1.44)	−2.53 (−1.65)	β_{MOM}	0.53 (0.37)
β_{GDP^z}					−0.27 (−1.03)	β_{GDP}	0.20 (0.67)
β_{IP^z}					0.23 (1.85)	β_{IP}	0.21 (0.98)
$\beta_{INF_{A^z}}$					0.05 (2.12)	β_{INF_A}	−0.06 (−1.30)
$\beta_{INF_{U^z}}$					60.10 (0.79)	β_{INF_U}	67.57 (1.04)
β_{MG^z}	0.81 (3.01)	0.77 (4.00)	0.53 (3.60)	0.48 (3.07)	0.34 (2.10)	β_{MG}	0.98 (2.63)
Adjusted R^2	0.63	0.63	0.74	0.74	0.85	Adjusted R^2	0.79

decreased than long-term interest rates. In the CSR tests, after adding factor loadings on *TERM* and *DEF* in the CSR models, the statistical and economic significance of *MG* betas is substantially weakened, although it does not completely disappear. This indicates that factor loadings on *TERM* and *DEF* capture a substantial portion of the explanatory power of *MG* betas. In other words, *MG* captures a substantial portion of the economic risk related to term spread and default spread and it might be related to term spread and default spread.[6]

4.5. Robustness Tests

4.5.1. Using Different Based Assets

Estimation of the tracking portfolios could be sensitive to the choice of base assets. It is necessary, therefore, to perform robustness tests using alternative base assets. To this end, we choose only the six equity portfolio sorted by on size and BM, as in Fama and French (1993). Panel A of Table 8 reports the CSR estimation results of the previously considered models within the two-pass methodology framework by using the whole-period betas. The gamma estimate on β_{MG} is similarly significant to the results in Panel A of Table 5. The estimates of the risk premium of *MG* in Models 4, 5, 6, and 7 are 0.51% per month (with a *t*-statistic of 2.76), 0.67% per month (with a *t*-statistic of 2.28), 0.45% per month (with a *t*-statistic of 2.01), and 0.72% per month (with a *t*-statistic of 3.11), respectively.

4.5.2. Pricing Ability of the Money Growth Factor After Controlling for SMB and HML Factors

The future money growth factor, *MG*, is constructed by using 10 industry-sorted stock portfolios and six stock portfolios sorted by book to market and firm size. Thus, *MG* might have some pricing information on *SMB* and *HML* that are formed from the six stock portfolios. It would be necessary to examine whether *MG* is still priced by orthogonalizing *MG* with respect to *SMB* and *HML*. To do so, we estimate the following time-series regression model:

$$MG_t = a_0 + a_1 SMB_t + a_2 HML_t + \xi_t. \tag{18}$$

Then, the sum of the intercept estimate and the residuals is regarded as the orthogonalized *MG* with respect to *SMB* and *HML*, $MG^{z(\mathrm{S/H})}$. Panel B of Table 8 presents the CSR estimation results of Models 4 through 7 in Panel A of Table 5 with the same test portfolios except that β_{MG} is replaced with $\beta_{MG^{\perp(\mathrm{S/H})}}$. The magnitude and statistical significance of the CSR coefficient estimates on $\beta_{MG^{\perp(\mathrm{S/H})}}$, $\hat{\gamma}_{MG^{\perp(\mathrm{S/H})}}$, and the adjusted R^2 are similar to the case in which β_{MG} is used. Specifically, when $\beta_{MG^{\perp}(\mathrm{S/H})}$ is alone in the model, $\hat{\gamma}_{MG^{\perp(\mathrm{S/H})}}$ is 1.30% with a *t*-statistic of 3.22. When the market beta is added to the model, $\hat{\gamma}_{MG^{\perp(\mathrm{S/H})}}$ is still statistically significant; it is 1.11% with a *t*-statistic of 2.80. When the Fama–French three-factor betas are added to the model, the statistical significance of $\hat{\gamma}_{MG^{\perp(\mathrm{S/H})}}$ is weakened; it is 0.46% with

[6]The results in detail are available up on request.

Table 8 Robustness tests for the use of different base assets and the orthogonalized future money growth factor

This table reports the month-by-month cross-sectional regression estimation results of portfolio excess returns on the whole-sample beta estimates, when base assets include only six equity portfolios sorted by size and BM as in Fama and French (1993) (in Panel A) and when the orthogonalized *MG* with respect to *SMB* and *HML* is used (in Panel B). The test portfolios are 25 size and BM portfolios formed by Fama and French (1993). *MKT* is the market return, *SMB* and *HML* are Fama and French (1993) factors related to firm size and book-to-market, respectively, *MOM* is the momentum factor, and *MG* is the factor reflecting innovations to future money growth. Numbers in parentheses indicate *t*-statistics. The sample period is from March 1995 to December 2008. The orthogonalized *MG* with respect to *SMB* and *HML*, $\beta_{MG^{z(S/H)}}$, is obtained by the sum of the intercept estimate and the residuals of the following time-series regression: $MG_t = a_0 + a_1 SMB_t + a_2 HML_t + \xi_t$.

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Panel A: Using different base assets							
Intercept	3.99 (1.40)	−2.13 (−1.22)	−3.78 (−2.17)	−2.35 (−1.93)	−3.76 (−1.54)	−2.28 (−1.35)	−4.28 (−2.42)
β_{MKT}	−3.43 (−1.20)	2.19 (1.15)	3.81 (1.98)		4.01 (1.56)	2.31 (1.23)	4.49 (2.31)
β_{SMB}		0.97 (1.86)	1.05 (2.00)			0.98 (1.88)	1.06 (2.03)
β_{HML}		1.21 (2.94)	1.29 (3.00)			1.26 (2.98)	1.11 (2.70)
β_{MOM}			−0.87 (−0.52)				0.81 (0.48)
β_{MG}				0.51 (2.76)	0.67 (2.28)	0.45 (2.01)	0.72 (3.11)
Adjusted R^2	0.09	0.65	0.68	0.57	0.57	0.65	0.71
Panel B: Using the orthogonalized *MG* with respect to *SMB* and *HML*							
Intercept				−3.86 (−2.78)	−0.58 (−0.24)	−2.04 (−1.16)	−4.55 (−2.73)
β_{MKT}					1.32 (0.52)	2.18 (1.20)	4.79 (2.78)
β_{SMB}						0.95 (1.75)	1.02 (1.86)
β_{HML}						1.16 (2.73)	1.10 (2.59)
β_{MOM}							−0.45 (−0.31)
$\beta_{MG^{z(S/H)}}$				1.30 (3.22)	1.11 (2.80)	0.46 (1.35)	1.03 (3.04)
Adjusted R^2				0.59	0.61	0.65	0.72

t-statistic of 1.35. However, the Fama–French four-factor betas are added to the model, it is still statistically significant; it is 1.03% with a *t*-statistic of 3.04. Overall, these results indicate that *MG* has a marginal contribution to explaining average stocks in Korea, even after adjusting for *SMB* and *HML*.

4.5.3. Over the Sub-Periods

Korean stock markets had a structural shift after the foreign currency crisis during 1997–1999. Thus, the estimation results could be different in the periods before and after the crisis. It is necessary, therefore, to examine the test results using different sub-periods. Table 9 reports the CSR results of the previously considered models within the Fama and MacBeth (1973) methodology framework over the two sub-periods: before the foreign currency crisis (1995–1999) and after the crisis (2000–2008). Panel A of Table 9 shows the CSR estimation results before the crisis. Over this sub-period, *MG* is overall insignificantly priced. Only in Model 7 (including all five factors) is the risk premium of *MG* statistically significant. Over the period after the crisis (in Panel B), however, *MG* is significantly priced in the most models considered. That is, the risk premiums of *MG* in Models 4, 5, and 7 are 0.70% per month (with a *t*-statistic of 2.91), 1.32% per month (with a *t*-statistic of 3.72), and 0.97% per month (with a *t*-statistic of 2.35), respectively.

4.5.4. Over the Different Business Cycles

Money growth shocks can affect investors' expectations over business cycles differently. We conjecture that money growth shocks could have greater impact on stock markets in recession periods than in expansion periods, because macro-level liquidity shock would play a more vital role in recession than in expansion.[7] To examine if there is a difference in pricing of *MG* between expansion and recession periods, we repeat the CSR tests over expansion and recession periods. We use the business cycle classification of the National Statistical Office, which uses the Cyclical Component of Coincident Composite Index. We choose the sample period from January 2000 to December 2008, because *MG* is significantly priced over this period.

Table 10 reports the CSR estimation results in expansion (in Panel A) and in recession (in Panel B) periods. Differently from our conjecture, the *MG* risk premium is significant in both periods, and its magnitude is similar. *t*-test statistics for the difference in the *MG* risk premium between expansion and recession periods are not significant in all models considered. However, the statistical significance of the *MG* risk premium is slightly stronger in recession periods than in expansion periods.

5. Conclusions

In the perspective of Merton's (1973) intertemporal capital asset pricing model, we propose revisions in the expectation of future money growth as a macroeconomic

[7]Choe and Yang (2006, 2010) examine the relation between micro-level liquidity and stock returns in Korea.

Table 9 Robustness tests for different sub-periods

This table reports the month-by-month cross-sectional regression estimation results of portfolio excess returns on the whole-period beta estimates over the two sub-periods. Panel A presents the results of the sample period from March 1995 to December 1999, and Panel B presents the results of the sample period from January 2000 to December 2008. *MKT* is the market return, *SMB* and *HML* are Fama and French (1993) factors related to firm size and book-to-market, respectively, *MOM* is the momentum factor, and *MG* is the factor reflecting innovations to future money growth. Numbers in parentheses indicate *t*-statistics. The adjusted R^2 is computed from Jagannathan and Wang (1996).

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Panel A: Sample period March 1995 to December 1999							
Intercept	7.82 (1.23)	−5.03 (−1.41)	−6.22 (−1.70)	−3.30 (−1.38)	−0.42 (−0.09)	−4.85 (−1.38)	−7.175 (−1.93)
β_{MKT}	−7.94 (−1.29)	4.49 (1.08)	5.66 (1.29)		0.02 (0.00)	4.46 (1.08)	6.89 (1.53)
β_{SMB}		1.80 (1.52)	1.85 (1.59)			1.75 (1.50)	1.81 (1.56)
β_{HML}		0.47 (0.50)	0.49 (0.52)			0.38 (0.41)	0.33 (0.34)
β_{MOM}			−1.79 (−0.47)				−1.29 (−0.34)
β_{MG}				1.06 (1.48)	0.68 (0.84)	1.07 (1.42)	1.60 (2.09)
Adjusted R^2	0.31	0.69	0.70	0.62	0.64	0.70	0.74
Panel B: Sample period January 2000 to December 2008							
Intercept	1.93 (0.70)	−0.57 (−0.30)	−2.48 (−1.35)	−1.56 (−1.26)	−6.18 (−2.17)	−0.56 (−0.29)	−3.13 (−1.57)
β_{MKT}	−1.01 (−0.35)	0.96 (0.50)	2.82 (1.57)		6.83 (2.35)	0.95 (0.49)	3.67 (1.85)
β_{SMB}		0.53 (1.08)	0.62 (1.22)			0.52 (1.03)	0.59 (1.16)
β_{HML}		1.60 (4.28)	1.63 (4.30)			1.57 (4.13)	1.51 (4.05)
β_{MOM}			−0.34 (−0.23)				0.01 (0.00)
β_{MG}				0.70 (2.91)	1.32 (3.72)	0.37 (0.98)	0.97 (2.35)
Adjusted R^2	0.01	0.67	0.72	0.39	0.48	0.68	0.75

Table 10 Robustness tests for different business cycles

This table reports the month-by-month cross-sectional regression estimate results of portfolio excess returns on the whole-period beta estimates over the different business cycle periods. Panel A presents the results for expansion periods, and Panel B presents the results of recession periods. We use the business cycle classification by National Statistical Office which uses the Cyclical Component of Coincident Composite Index. Numbers in parentheses indicate *t*-statistics. The sample period is from January 2000 to December 2008.

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Panel A: Expansion periods							
Intercept	3.57 (0.90)	0.79 (0.32)	−2.01 (−0.98)	−0.94 (−0.55)	−5.31 (−1.41)	0.72 (0.31)	−2.48 (−1.08)
β_{MKT}	−1.73 (−0.40)	0.44 (0.19)	3.18 (−1.55)		6.85 (1.70)	0.45 (0.19)	3.79 (1.59)
β_{SMB}		0.68 (0.94)	0.799–1.09			0.69 (0.95)	0.78 (1.06)
β_{HML}		1.82 (5.46)	1.86 (5.61)			1.86 (5.73)	1.79 (5.52)
β_{MOM}			0.51 (0.27)				0.76 (0.42)
β_{MG}				0.80 (2.38)	1.38 (3.08)	0.12 (0.23)	0.85 (1.59)
Adjusted R^2	0.02	0.70	0.77	0.40	0.47	0.70	0.78
Panel B: Recession periods							
Intercept	−1.21 (−0.31)	−3.19 (−1.22)	−3.38 (−1.23)	−2.75 (−1.43)	−7.85 (−2.42)	−2.91 (−1.12)	−4.39 (−1.54)
β_{MKT}	0.38 (0.09)	1.95 (0.61)	2.14 (0.76)		6.79 (2.00)	1.91 (0.6)	3.45 (1.2)
β_{SMB}		0.26 (0.39)	0.26 (0.39)			0.18 (0.27)	0.22 (0.32)
β_{HML}		1.16 (3.01)	1.17 (2.94)			1.03 (2.42)	0.993 (2.4)
β_{MOM}			−1.97 (−0.82)				−1.44 (−0.56)
β_{MG}				0.51 (1.75)	1.19 (3.87)	0.86 (1.98)	1.19 (2.66)
Adjusted R^2	0.00	0.42	0.42	0.23	0.35	0.47	0.49
Panel C: *t*-test statistic for the difference in the *MG* risk premium between expansion and recession periods							
β_{MG}				0.63	0.29	−1.02	−0.39

state variable that is closely related to macroeconomic conditions and business cycle fluctuations. We then examine whether innovation in the expectation of future money growth is priced on stock returns in the Korean stock markets after controlling for the market factor, Fama and French's *SMB* and *HML*, and the momentum factor. To obtain the risk factor that captures innovations in future money growth, narrow money (M1) is used as a measure of money supply. The future money growth is measured by the 3-month ahead future money supply growth.

In the cross-sectional regression tests and the GMM tests, we find that the factor related with innovations in the expectation of future money growth is significantly priced in Korea, even after controlling for well-known factors such as the market factor, Fama and French's *SMB* and *HML*, and the momentum factor. *SMB* and *HML* are also significantly priced. Thus, the future money growth factor has a significant marginal contribution in pricing stocks in Korea, which implies that it captures an economic risk that *SMB* and *HML* do not. We also find that this economic risk is related to term spread and default spread. Because the money growth factor might contain information on the pricing ability of other macroeconomic factors, we examine the pricing ability of *MG* after controlling for other macroeconomic factors. We find that the money growth factor still has a significant explanatory power for average stock returns even after controlling for the real macroeconomic variables such as *GDP*, industrial production, anticipated inflation, and unanticipated inflation.

We conduct several robustness checks. Because the above results are sensitive to the choice of base assets, we use different base assets. The results are similar. Another interest finding is that the money growth factor is significantly priced over the period after the foreign currency crisis in 1997, but is insignificantly priced before the crisis. This indicates that the future macro liquidity shock plays a significant role in determining investors' expectation of stock returns after the foreign currency crisis. In another robustness test, we find that the pricing ability of *MG* is slightly stronger in recession periods than in expansion periods, although the difference in the *MG* risk premium between these two business cycles is statistically insignificant.

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