Emerging Markets Finance & Trade, 52:1438–1454, 2016

ISSN: 1540-496X print/1558-0938 online
DOI: 10.1080/1540496X.2015.1046767

Macro Liquidity Risk, Money Growth, and the Cross-Section of Stock Returns: The Case of Korea

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ABSTRACT: According to the homogeneity of money holding purpose, we decompose the broad money M2 into an underlying and a non-underlying part and propose innovations in future non-underlying M2 growth as a proxy for macro liquidity. In both the cross-sectional regression tests and the GMM tests, we find that risk related to innovations in future non-underlying M2 growth is strongly significantly priced in Korea, after controlling for the well-known risk factors and other macroeconomic variables. Meanwhile, risk related to innovations in future aggregate or underlying M2 growth is insignificantly priced. These results indicate that non-underlying M2 growth more directly affects macro liquidity than does aggregate or underlying M2 growth.

KEY WORDS: broad money M2, cross-sectional regression test, economic tracking portfolio, GMM tests, innovations in future money growth, risk factor, underlying and non-underlying M2

The issue of whether and how money growth affects stock prices is critical to financial economists and monetary regulators as well as practitioners. In particular, this issue becomes more important since the recent global financial crisis. Money growth, which is controlled by central banks, affects market-wide liquidity (equivalently, macro liquidity or money flow liquidity) and ultimately the level of capital available for investors to trade securities (equivalently, micro liquidity or transaction liquidity).[1] Liquidity is defined as the ability to trade large quantities of a security quickly, at low cost, and without affecting its price. Liquidity is risky, since it could adversely affect the tradability of securities and the performance of stock price, especially when the market is in downturn and liquidity suddenly dries up. Therefore, unexpected changes in money growth can cause unfavorable shifts in the investment opportunity set. In the perspective of Merton's (1973) Intertemporal Capital Asset Pricing Model (ICAPM), we regard unexpected changes in money growth as a state variable and argue that there will be risk associated with unexpected changes in money growth.

Money growth is of course not a unique state variable that could cause shifts in the investment opportunity set. A number of researchers analyze several other macroeconomic variables as state variables and examine whether risk associated with innovations in state variables is priced. Arguably, the most notable among these articles are as follows. Merton (1973) regards risk-free interest rate as a state variable in deriving his ICAPM. Chen, Roll, and Ross (1986) explore a set of macroeconomic variables (industrial production, default spread, term spread, and inflation) as state variables and examine their influence on asset pricing. These authors find that these variables systematically affect stock returns. In a recent article, Vassalou (2003) uses GDP growth as a state variable and shows that innovations in future GDP growth affect stock prices systematically. Kim, Kim, and Min (2011) apply a similar approach to Vassalouby regarding labor income growth as a state variable and showing that innovations in future labor income growth are priced.

Money growth can also be one of the most plausible proxies for a state variable, since growth in money supply affects the production markets as well as the capital markets and it is apparently one of the sources affecting macroeconomic conditions and eventually stock returns. Notably,

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Flannery and Protopapadakis (2002) present evidence that a monetary aggregate (generally M1) is the candidate for priced factors and is only the variable among seventeen macroeconomic variables that affects both stock returns and conditional volatility. Narrow money M1 can be first considered as the candidate for the state variable.[2] Jung and Kim (2011) use money growth in M1 as a state variable and show that a risk factor associated with money growth in M1 is priced in Korea. However, narrow money M1 does not include holdings of some financial instruments such as money market funds and short-term marketable financial instruments that can be quickly converted into cash with little frictions. Changes in holdings of such financial instruments affect investors' liquidity and changes in the composition of their portfolios, which eventually affect stock prices. It is necessary, therefore, to use broad money M2 rather than M1 in analyzing the relation between stock returns and changes in money supply. After the recent global financial crisis, monetary authorities in many countries have begun to take a closer look at the part of M2 not being included in M1 to monitor changes in macro liquidity.

Broad money M2 is held by money demand sectors such as households, firms, and governments. Among broad money M2, some part is needed by households and some firms to meet their basic needs such as consumption and normal business operations and is unlikely to flow into stock markets, while the remaining part is more likely to flow into and back from stock markets. Changes in the latter part are more likely to affect liquidity in stock markets and eventually stock prices. We therefore argue that it is necessary to decompose broad money M2 into the two parts and it is more appropriate to use changes in the latter part as a macroeconomic state variable rather than changes in the former part or in the aggregate part in analyzing the relation between stock returns and money growth. To do this, we use the case of Korea.

The Bank of Korea defines the (aggregate) broad money M2 as the sum of narrow money M1 and the following: (1) savings and short-term time deposits, money market funds, negotiable financial instruments such as CDs, RPs and cover bills, short-term financial debentures, and short-term money in trust, and (2) beneficiary certificates.[3] To analyze effectively the money demand by sector and understand an underlying money stock, the Bank of Korea recently breaks down broad money M2 into two parts: an underlying and a non-underlying part. Underlying M2 is the part of M2 held by the household and the nonfinancial corporation sectors which is necessary to meet their basic needs such as consumption and normal business operations. Non-underlying M2 is the remaining portion of M2 after deduction of the underlying M2. We therefore argue that underlying M2 is unlikely to flow into stock markets and that liquidity related to changes in non-underlying M2 affects stock prices through transaction liquidity (or micro liquidity) more directly than does aggregate or underlying M2.

In this article, we propose non-underlying M2 growth as a macroeconomic state variable and examine whether innovations in the expectation of future non-underlying M2 money growth are priced in the Korean stock markets. To construct the risk factor that captures innovations in the expectations of future non-underlying M2 growth, which are unobservable, we adopt the economic tracking portfolio approach 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 state variable. This economic tracking portfolio is a factor portfolio and the loadings on this factor portfolio are macro liquidity betas. This article examines whether these factor loadings can explain the cross-section of expected returns or whether expected stock returns are related to macro liquidity risk in returns. This article is similar to Pastor and Stambaugh (2003) and Acharya and Pedersen (2005) in that factor loadings on the liquidity factor are used to explain the cross-section of expected stock returns. This article differs from those two studies, however, in that they both use aggregate market-wide liquidity as a liquidity factor by cross-sectionally summing up individual stocks' measures of liquidity, while we use a factor mimicking portfolio. Note that their aggregate market-wide liquidity is not a factor portfolio. To our knowledge, this article is the first one that uses growth in non-underlying M2 as a state variable in analyzing stock returns and macro liquidity.

Using both the cross-sectional regression tests and the generalized method of moments (GMM) tests, we find that a risk factor related to innovations in the expectation of future non-underlying M2 growth is significantly priced in Korea, regardless of controlling for the mutual influence between underlying and non-underlying M2 growth or for the other macroeconomic variables. These results are obtained after controlling for the well-known factors like the Fama and French (1993) three factors and the (transaction) liquidity factor. Meanwhile, the factor associated with underlying M2 growth is not priced after controlling for some effects. The risk factor associated with money growth in M1 of Jung and Kim (2011) is no longer significantly priced after controlling for the risk factor related to non-underlying M2 growth. These results indicate that non-underlying M2 growth plays a much more important role in pricing stocks in Korea. Therefore, this article provides an important monetary policy implication that a more effective way to manage macro liquidity risk is to control non-underlying M2 growth rather than either aggregate or underlying M2 growth.

The rest of this article is organized as follows. The next section explains the breakdown of (aggregate) broad money M2 into an underlying and a non-underlying part, the third section discusses the methodology for estimating the economic tracking portfolio and for testing the significance of the models. Section 4 reports the empirical results and the final section presents the conclusions.

Underlying and Non-Underlying Broad Money M2 in Korea

The Bank of Korea defines four money demand sectors as (1) households (including nonprofit institutions serving households), (2) nonfinancial corporations, (3) financial corporations excluding depository corporations, and (4) others such as units of government other than the central governments.

The purpose of holding money may differ across sectors. Households demand money basically for consumption. Nonfinancial corporations demand money basically for their need to finance normal business transactions such as wage payments and the purchase of goods for production. These corporations also hold money to execute transactions and to avoid missing investment or production opportunities due to a lack of immediately available funds. These two sectors also demand money for nonbasic purposes such as investments in financial assets (i.e., beneficiary certificates).[4] Financial corporations (excluding depository corporations) need money for the settlement of financial transactions for households, nonfinancial firms, and their own. Therefore, growth in these financial firms' money holdings reflects developments in asset markets and to some extent a speculative demand for assets. Basically, these financial intermediaries hold money on the basis of asset portfolio considerations. Of course, the third and fourth sectors also hold money for the purpose of investments in beneficiary certificates.

The Bank of Korea breaks down broad money M2 into an underlying and a non-underlying part according to the homogeneity of money holding purposes, regardless of money demand sectors. Underlying M2 is the part of M2 held by households and nonfinancial corporation sectors necessary for basic money holding purposes such as consumption and normal business operations, respectively. Thus, these two sectors' money holdings for investment in beneficiary certificates are not included in underlying M2. Non-underlying M2 is the part of M2 held by financial corporations other than depository institutions and units of governments other than the central government sector, plus beneficiary certificates held by all four sectors. Among the broad money M2, therefore, non-underlying M2 is the part of M2 that could affect directly the level of market-wide macro liquidity.

Table 1 presents annual growth rates in M2 holdings by each sector and shows a sectoral breakdown (in percent in parentheses) of the aggregate M2 held by each sector over the period 2002–13. The breakdown of M2 by money holding sector suggests that households constitute the largest holder of M2 representing more than a half of the aggregate M2 stock. Nonfinancial corporations and financial corporations (other than depository corporations) sectors are the second and third largest holders of M2, and units of governments other than the central governments the smallest holder of M2. Among these money holding sectors, the financial corporations and units of governments sectors have the largest volatility in the growth rates of their M2 holdings. Another notable observation is that growth rates in non-underlying M2 are twice as volatile as those in underlying M2.

Table 1. Annual growth rates in M2 by sectors in Korea

Beneficiary certificates included?	Households (1) Yes		Non-financial corporations (2) Yes		Households (1)' No		Non-financial corporations (2)' No		Financial corp. excl. depository corp. (3) Yes		Others (4) Yes		Underlying M2 (1)'+(2)'		Non-Underlying M2 (3)+(4)+[(1)–(1)'] +[(2)–(2)']	
2002.12	10.62	(54.79)	9.33	(21.61)	10.88	(51.41)	7.99	(18.81)	10.50	(16.77)	34.73	(6.83)	10.09	(70.22)	11.68	(29.78)
2003.12	2.80	(54.56)	1.77	(21.30)	4.22	(51.91)	4.98	(19.13)	5.65	(17.17)	5.44	(6.98)	4.43	(71.03)	3.23	(28.97)
2004.12	4.46	(54.82)	5.12	(21.54)	5.20	(52.53)	3.41	(19.03)	2.28	(16.89)	0.56	(6.75)	4.72	(71.56)	3.95	(28.44)
2005.12	7.22	(54.49)	14.19	(22.80)	6.38	(51.81)	16.67	(20.58)	9.81	(17.19)	–11.87	(5.51)	9.12	(72.39)	7.87	(27.61)
2006.12	13.39	(55.65)	7.77	(22.13)	11.05	(51.81)	6.49	(19.74)	9.35	(16.93)	6.55	(5.29)	9.76	(71.55)	11.04	(28.45)
2007.12	8.64	(57.27)	9.14	(22.88)	–0.46	(48.86)	9.89	(20.55)	–10.60	(14.34)	9.84	(5.51)	2.39	(69.41)	5.55	(30.59)
2008.12	11.05	(58.07)	12.08	(23.42)	10.48	(49.29)	15.35	(21.64)	–0.64	(13.01)	9.42	(5.50)	11.92	(70.93)	9.52	(29.07)
2009.12	8.34	(56.65)	16.63	(24.59)	13.96	(50.58)	16.30	(22.66)	23.27	(14.44)	–12.82	(4.32)	14.68	(73.24)	11.06	(26.76)
2010.12	6.37	(56.52)	4.31	(24.06)	10.68	(52.51)	4.87	(22.29)	11.33	(15.08)	7.10	(4.34)	5.75	(74.80)	10.36	(25.20)
2011.12	3.85	(56.45)	11.54	(25.86)	3.61	(52.46)	10.77	(23.78)	0.12	(13.52)	4.26	(4.16)	5.74	(76.24)	3.57	(23.76)
2012.12	3.19	(55.65)	4.28	(25.77)	4.32	(52.28)	5.03	(23.86)	8.02	(13.95)	16.45	(4.63)	4.54	(76.14)	5.12	(23.86)
2013.12	3.63	(55.34)	7.73	(26.63)	4.57	(52.45)	8.29	(24.79)	2.79	(13.76)	–4.09	(4.26)	5.73	(77.25)	–0.64	(22.75)
Ave	6.96		8.66		7.07		9.17		5.99		5.46		7.58		5.30	
Std dev	3.50		4.41		4.23		4.71		8.29		12.67		3.11		6.04	
Coeff. variation	0.50		0.51		0.60		0.51		1.38		2.32		0.41		1.14	

The Estimation of the Risk Factor

Constructing the Economic Tracking Portfolios

To construct a risk factor related to innovations in the non-underlying M2 growth, we employ the economic tracking portfolio approach by Lamont (2001). The first step in this approach is to estimate the following regression model:

$$g(\mathrm{NU})_{t,t+s} = cB_{t-1,t} + dZ_{t-2,t-1} + \eta_{t,t+s}, \tag{1}$$

where g(NU) is the growth rate in the non-underlying M2; $B_{t-1,t}$ is the vector of the excess returns of base assets over the risk-free rate between $t-1$ and t; $Z_{t-2,t-1}$ is the vector of the intercept and the control variables between $t-2$ and $t-1$; $\eta_{t,t+s}$ represents the random error terms; and c and d are the regression coefficient vectors to be estimated. Thus, $g(\mathrm{NU})_{t,t+s}$ is the future growth in non-underlying M2 predicted s-month ahead between month t and $t+S$. The implicit assumption in Equation (1) is that current asset returns reflect news from s months ahead on future non-underlying money growth.

After estimating the regression model (2) using monthly data, we compute returns on the tracking portfolio as

$$\mathrm{MG\_NU}_{t-1,t} = \hat{c}\,B_{t-1,t} \tag{2}$$

where $\mathrm{MG\_NU}_{t-1,t}$ is the return on the economic tracking portfolio. This is a risk factor related to innovations in expectations about future non-underling M2 growth. Thus, returns on the economic tracking portfolios are obtained by multiplying the base assets' returns by the estimated value of the coefficient vector c from Equation (1). Thus, the coefficient vector c indicates the weights of base assets for the tracking portfolio. In fact, an economic tracking portfolio is a type of the "maximum correlation portfolio" of Breeden, Gibbons, and Litzenberger (1989). It has returns that have a maximum correlation with the target variable of a portfolio consisting of the base assets. Risk factors related to innovations in expectations about future underlying M2 and aggregate M2 growth, MG_U and MG_M2, are also similarly constructed through Equations (1) and (2).

The necessary condition for the base assets is that they are informative about innovations in expectations of future growth in a macroeconomic state variable such as non-underlying M2. The control variables (i.e., lagged $Z_{t-2,t-1}$) should have the ability of predicting base asset returns. The base assets used to construct the tracking portfolio are zero-investment portfolios, since the risk-free rate of returns is subtracted from each of the base asset returns. Thus, there is no restriction in estimating the portfolio weights, c. The estimation of the economic tracking portfolios through Equation (1) imposes no particular model of asset prices or equilibrium conditions. The only assumption used in deriving Equation (1) 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.[5]

Testing Methodologies

Cross-Sectional Regression Methods

We estimate the following CSR model. For a given month t,

$$r_{i,t} = \gamma_0 + \gamma'\hat{\beta}_{i,t-1} + e_{i,t}, \tag{3}$$

where $r_{i,t}$ is the excess return on asset i over the risk-free rate; $\hat{\beta}_{i,t-1}$ is the $(K \times 1)$ factor loadings vector of asset i estimated from the time-series regression by rolling over month-by-month the past thirty-six months available up to the estimation month t; $e_{i,t}$ is the error term; and γ is the $(K \times 1)$ parameter vector of the risk premia to be estimated. To judge the overall fit of each asset pricing model in the CSR, we adopt the cross-sectional R^2 measure employed by Lettau and Ludvigson (2001) as a summary statistic. This measure is computed as

$$R^2 = \frac{\mathrm{Var}(\bar{r}) - \mathrm{Var}(\bar{e})}{\mathrm{Var}(\bar{r})}, \tag{4}$$

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 average residual returns.

The Generalized Method Moments Tests

The ordinary least squares (OLS) estimation for the CSR model is invalid when some of the basic assumptions in the regression model estimation are violated. For example, the error terms ($e_{i,t}$) and the explanatory variables ($\hat{\beta}_{i,t-1}$) in Equation (3) are not independent, since estimated betas used as the explanatory variables are correlated with the error terms. In this case, risk premia estimates are biased (see Shanken 1992; Kim 1995, 1997). Further, the error terms are usually heteorskedastic and correlated with each other in the CSR, which leads to inconsistent estimation for risk premia. Since the GMM estimation is robust for these cases, we perform the GMM test as a robustness check.

The GMM estimation is described as follows. When there is no arbitrage, there exists a positive stochastic discount factor (SDF) (or pricing kernel) m_{t+1} such that

$$E_t[m_{t+1}R_{t+1}] = 1_n, \tag{5}$$

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

$$m_{t+1} = b_0 + b_1' f_{t+1}, \tag{6}$$

where f_{t+1} is a $(K \times 1)$ vector of factors; b_0 and b_1 are an intercept and a $(\mathrm{K} \times 1)$ coefficient vector, respectively, which are called the SDF loadings.

To simultaneously estimate the tracking portfolios (i.e., estimating coefficients c and d in Equation [1]) and the coefficients in the SDF (i.e., b_0 and b_1 Equation [6]), the orthogonality condition of Equation (1) is stacked at the moment condition of the asset pricing model of Equation (5) such that

$$g(\theta) = \begin{pmatrix} E\left[\eta_{t,t+4} \otimes z_t\right] \\ E_t[m_{t+1}R_{t+1} - 1_n] \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \tag{7}$$

where $\theta = (b_0, b_1, c, d)$ represents the parameters to be estimated, and $z_t = \left[B_{t-1,t} : Z_{t-2,t-1}\right]$ is a vector of the explanatory variables in Equation (1). However, when risk factor f_{t+1} is already determined, it is natural to estimate only the coefficients in the SDF, and thus only the moment condition of the asset pricing model of Equation (10) is used such that

$$g(\theta) = (E[m_{t+1}R_{t+1} - 1_n]) = (0), \tag{8}$$

where $\theta = (\mathrm{b}_0, \mathrm{b}_1)$. Parameters θ are chosen by minimizing the quadratic form

$$J_T = g(\theta)' W g(\theta), \tag{9}$$

where W is a weighting matrix that defines the metric used to make g close to zero. Since 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 (8). In order to make a fair comparison, the pricing ability of our alternative model is also estimated in the same way as the competing models.

As the weighting matrix in Equation (9) is used to minimize the quadratic equation J_T, we use the Hansen and Jagannathan (1997) weighing matrix, $E[RR']^{-1}$, which is the inverse of the second moments of asset returns. Its main advantage is that it is invariant across competing asset pricing models. To compare the performance of pricing ability across models, we also use this weighting matrix in computing the Hansen-Jagannathan distance (HJ-distance). According to Cochrane (1996), the risk premia, λ, can be estimated in the SDF approach as follows

$$\lambda = -r_f Cov(f, f') b_1, \tag{10}$$

where r_f is the riskless return; f is a $(K \times 1)$ vector of the factors; and b_1 is a $(K \times 1)$ coefficient vector in the pricing kernel of Equation (6).

Empirical Results

Selecting Base Assets and Control Variables

The choice of base assets is essential to construct the tracking portfolio that reflects innovations related to future money growth in non-underlying M2. Base assets should be informative about the changes in expectations about future money growth. In this study, we choose ten industry-sorted portfolios and six equity portfolios sorted by book to market and firm size as in Fama and French (1993). All these sixteen portfolios are value-weighted. All stocks traded in Korea Stock Exchanges are used to form the base assets.

To construct the tracking portfolio, we also need control variables to capture unexpected components of base assets' returns. Control variables should have the ability of predicting future stock returns. Thus, we include the one-month Monetary Stabilization Bond yield (RF) as the riskless rate of return, the default spread (DEF), and the term spread (TERM) as the control variables.[6] Since money growth rates tend to be serially correlated, we also include a lagged value of the money growth rate (i.e., $g(NU)_{t,t-s}$) as a control variable to isolate innovations in the money growth rates. DEF is the difference between the yield of AA–corporate bonds and Korean government bonds yields, and TERM is the difference between the yields of five-year Korean government bonds and a one-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. This set of the control variables are also used in Kapadia (2011).

Predictability of the Base Assets for Future Non-Underlying Money Growth

Since base assets should reflect innovations of expected future non-underlying M2 growth, it is important to examine whether returns on the chosen base assets are actually able to predict future money growth. To do this, we regress future non-underlying M2 growth rates from t to $t+s$ on returns of the sixteen base assets and the control variables as in Equation (1). There is no theoretical justification in determining the value of s. To determine a reasonable value of s for the reliable and stable regression coefficient estimates on the base asset returns, we estimate the regression model of Equation (1) for $s = 1, 2, 3, 4, 5, 6, 9,$ and twelve months, respectively, and choose the value of s based on a statistical justification. The estimation period is from November 2001 to December 2013.

The regression model (2) is estimated for each value of s. The estimation results (not reported) show that the asymptotic p-values of the Wald test for the null hypothesis and that the regression coefficients on the base assets' returns are jointly zero (i.e., $H_0 : c = 0$) and is less than 5 percent only when $s =$ twelve months.[7] This indicates that the null hypothesis of no forecasting ability of the base assets for innovations in future non-underlying M2 growth is most strongly rejected when $s =$ twelve months. In other words, current stock returns best reflect news from twelve months ahead on future non-underlying money growth. Further, the R^2 is the greatest when $s =$ twelve months. Therefore, we set$s =$ twelve months in estimating returns on the tracking portfolio and use the twelve-month ahead future non-underlying M2 growth factor.[8] Although we determine the value of s based on a statistical justification, the results from using $s =$ twelve months are coincidently robust to seasonality in money growth.[9]

After estimating the regression coefficients of Equation (1), returns on the tracking portfolio are obtained by multiplying the estimated regression coefficients by returns on the base assets as in Equation (2). We regard these returns as a risk factor associated with innovations in the expectation of future non-underlying M2 growth and denote it as MG_NU. Using the above approach, we also similarly construct risk factors associated with innovations in the expectation of future aggregate M2 and underlying M2 growth. The results show that the null hypotheses of no forecasting ability of the base assets for innovations in future aggregate M2 and underlying M2 growth are also rejected when $s =$ twelve months (not reported). To estimate returns on the tracking portfolios for the cases of future aggregate M2 and underlying M2 growth, therefore, we set $s =$ twelve months. We denote them as MG_M2 and MG_U, respectively.

Money Growth Risk Factors

Table 2 presents the summary statistics of the seven risk factors considered over the entire sample period from November 2001 to December 2013: excess market returns (MKT) over the risk-free rate, the Fama and French factors related to size and book to market (SMB and HML, respectively), the liquidity factor (LIQ) based on the turnover measure of Lesmond (2005),[10] and three risk factors

Table 2. Descriptive statistics

	MKT	SMB	HML	LIQ	MG_M2	MG_NU	MG_U
				Average return (%)			
	0.883	0.423	1.205	0.985	–0.037	0.560	–0.309
				Standard deviation (%)			
	6.184	3.432	3.083	6.347	1.198	5.147	1.087
				t-statistic			
	1.54	0.33	4.23	1.88	0.81	2.64	–4.38
				Correlation coefficient			
MKT	1.000	–0.212	0.021	–0.270	0.547	0.503	–0.074
SMB		1.000	–0.016	–0.231	0.364	0.322	0.175
HML			1.000	0.341	0.206	0.318	–0.305
LIQ				1.000	–0.262	–0.269	–0.017
MG_M2					1.000	0.881	0.227
MG_NU						1.000	–0.211
MG_U							1.000

Notes: MKT is the excess market return over the risk-free rate, SMB and HML are the factors related to firm size and book-to-market, LIQ is the liquidity factor based on the turnover measure of Lesmond (2005), and MG_M2, MG_NU. and MG_U are the risk factors reflecting innovations related to future aggregate M2, non-underlying M2, and underlying M2 growth, respectively.

related to innovations in the expectation of future money growth in aggregate M2, non-underlying M2, and underlying M2 (MG_M2, MG_NU, and MG_U, respectively). The average monthly returns of the Fama and French three factors (MKT, SMB, and HML) are 0.883 percent (t-statistic of 1.54), 0.423 percent (t-statistic of 0.33), and 1.205 percent (t-statistic of 4.23), respectively. In particular, HML is strongly significant in Korea, while SMB is insignificant. The average return of LIQ is 0.985 percent (t-statistic of 1.88). Note that the liquidity factor, LIQ, is a risk factor for transaction liquidity.

Among the three money growth factors, the risk factor related to non-underlying M2 growth, MG_NU, has particularly high average returns relative to the other money growth risk factors. Specifically, average monthly returns of MG_M2, MG_NU, and MG_U are −0.037 percent (t-statistic of 0.81), 0.560 percent (t-statistic of 2.64), and −0.309 percent (t-statistic of −4.38), respectively. MG_NU also has much greater standard deviation than do the other money growth factors. The correlation coefficients of MG_NU with the other risk factors, MKT, SMB, HML, LIQ, MG_M2 and MG_U are 0.503, 0.322, 0.318, −0.269, 0.881, and −0.211, respectively.

Cross-Sectional Tests

A Systematic Pattern in Factor Loadings on Money Growth Risk Factors

To preliminarily examine the relation between average returns and factor loadings (or betas) on the money growth (MG) risk factors, we investigate whether there is a systematic pattern in MG betas across firm size and BM.[11] We choose twenty-five portfolios sorted by size and BM as in Fama and French (1993), since these portfolios are one of the most commonly used test assets in the literature. Table 3 presents the factor loadings on the six considered risk factors across twenty-five size-BM portfolios. All twenty-five factor loadings on MG_NU, β_{MG_NU}, are statistically significantly estimated. More important, the estimated factor loadings show a systematic pattern across both firm size and BM. That is, β_{MG_NU} overall decreases with firm size within each BM quintile and increases with BM within each firm size quintile portfolio. This pattern of β_{MG_NU} is almost consistent with the pattern of average returns across firm size and BM. This is indirect evidence that there is a strong positive relation between β_{MG_NU} and average stock returns. In particular, the smallest and the largest values of β_{MG_NU} occur at the lower-left and upper-right corners of the table, where the smallest and the largest average returns occur, respectively. However, factor loadings on the other MG risk factors do not show as clear a pattern as does β_{MG_NU}. Moreover, only two factor loadings on MG_U, β_{MG_U}, among twenty-five are estimated significantly.

Results of Cross-Sectional Regression Tests

It was preliminarily observed in the previous sections that there is a positive cross-sectional association between factor loadings on the future non-underlying M2 growth factor (β_{MG_NU}) and average returns. To formally examine whether the risk associated with innovations in future money growth is priced, we estimate month-by-month CSR of Equation (3) and take averages of the CSR coefficient estimates as risk premia estimates.

Table 4 presents time-series averages of the CSR coefficient estimates ($\widehat{\gamma}$) over the entire sample period from November 2001 to December 2013 for the CAPM, the Fama, and French three-factor model (FF3), and the various models combining the CAPM or FF3 with the MG risk factors. We use twenty-five size-BM portfolios as main test assets. We also use individual stocks as alternative test assets to avoid a data snooping bias. Another reason to use individual stocks as test assets is that any spurious factor can seem to be relevant if it is correlated with the size (or the book-to-market) factor and the first set of test assets may have a strong factor structure (Lewellen, Nagel, and Shanken 2010).[12] In this article, we use the predictive betas in all CSR estimations as explanatory variables, which are estimated by rolling over month-by-month the past thirty-six months available up to the estimation month. In conclusion, the non-underlying M2 growth beta, β_{MG_NU}, is significantly

Table 3. Factor loading estimates of the risk factors

	Low	2	3	4	High	Low	2	3	4	High
			β_{MKT}					$t(\beta_{MK})$		
Small	0.95	0.90	0.85	0.86	0.86	6.02	6.76	8.00	7.94	6.85
2	0.89	0.90	0.91	0.90	1.03	7.69	8.85	10.35	9.20	8.85
3	0.95	1.03	0.97	0.95	1.05	10.11	11.54	12.57	11.34	7.69
4	1.09	1.04	0.97	0.98	1.06	9.98	12.59	13.60	10.34	10.76
Large	0.89	1.05	1.08	1.11	1.12	12.76	19.15	34.04	17.33	18.63
			β_{SMB}					$t(\beta_{SMB})$		
Small	1.40	1.24	0.87	0.93	0.78	5.23	4.82	3.99	3.99	3.71
2	0.69	0.75	0.40	0.39	0.55	2.76	3.02	1.97	2.03	2.03
3	0.28	0.00	–0.03	0.03	0.34	1.39	0.02	–0.15	0.14	1.31
4	–0.23	–0.17	–0.29	–0.18	–0.20	–1.21	–0.70	–1.40	–0.86	–0.73
Large	–0.41	–0.59	–0.59	–0.55	–0.47	–2.61	–2.99	–2.78	–2.40	–1.91
			β_{HML}					$t(\beta_{HML})$		
Small	–0.59	–0.13	0.41	0.62	0.72	–1.91	–0.44	2.04	2.64	3.04
2	–0.25	0.31	0.57	0.97	0.92	–1.28	1.37	2.59	4.39	3.99
3	–0.14	0.34	0.54	0.70	1.04	–0.68	1.58	2.97	3.84	4.17
4	–0.02	0.38	0.42	0.75	1.14	–0.10	1.81	2.02	3.46	5.59
Large	–0.09	–0.01	0.14	0.36	0.63	–0.49	–0.05	0.78	1.69	3.41
			β_{MG_M2}					$t(\beta_{MG\_M2})$		
Small	5.48	5.39	4.57	4.97	4.84	6.56	9.00	7.42	8.93	7.93
2	3.65	4.24	4.32	4.47	4.79	5.51	6.10	7.20	8.05	6.27
3	3.88	4.13	3.63	3.72	4.96	5.21	6.16	5.30	5.57	6.33
4	3.51	3.79	3.54	3.69	3.84	4.29	5.45	5.26	4.77	4.77
Large	2.43	3.07	2.92	3.77	3.25	3.93	4.28	4.65	5.25	4.15
			β_{MG_NU}					$t(\beta_{MG\_NU})$		
Small	1.09	1.12	1.05	1.13	1.19	5.42	8.70	8.25	8.93	8.57
2	0.78	1.00	0.98	1.08	1.15	4.55	7.02	7.88	9.62	7.15
3	0.82	0.91	0.84	0.91	1.11	4.79	5.86	6.00	6.43	6.77
4	0.80	0.87	0.81	0.87	0.92	4.13	5.39	5.52	5.47	5.88
Large	0.61	0.75	0.71	0.90	0.80	4.00	5.05	5.24	6.52	5.45
			β_{MG_U}					$t(\beta_{MG\_U})$		
Small	1.66	0.28	–0.22	–0.21	–1.19	1.60	0.32	–0.33	–0.32	–1.74
2	0.35	–0.36	–0.20	–0.96	–1.03	0.44	–0.44	–0.31	–1.52	–1.48
3	0.47	0.05	–0.36	–0.89	–0.96	0.64	0.08	–0.57	–1.36	–1.35
4	–0.47	–0.20	–0.17	–0.79	–1.17	–0.62	–0.30	–0.25	–1.22	–1.81
Large	–1.07	–1.09	–0.99	–1.10	–1.25	–1.72	–1.58	–1.42	–1.62	–1.86

Notes: The *t*-statistics are corrected for autocorrelation and heteroskedasticity using the Newey-West (1987) estimator with three lags, are reported. The sample period is from November 2001 to December 2013.

Table 4. Cross-section regression estimation results

	Model									
Explanatory variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Panel A: Using 25 size and B/M-sorted portfolios									
β_{MKT}	−2.43	1.65	−0.31	1.96	−2.69	1.25	0.73	1.61	1.17	2.28
	(−1.72)	(1.22)	(−0.22)	(1.26)	(−1.67)	(0.86)	(0.51)	(1.19)	(0.84)	(1.44)
β_{SMB}	.	.	0.59	.	.	.	0.63	0.67	0.64	0.70
	.	.	(1.86)	.	.	.	(1.96)	(2.11)	(2.01)	(2.20)
β_{HML}	.	.	1.06	.	.	.	0.97	0.91	0.95	1.02
	.	.	(3.57)	.	.	.	(3.26)	(3.04)	(3.17)	(3.45)
β_{LIQ}	1.47	.	.	.	.	.	.	.	.	1.29
	(1.59)	.	.	.	.	.	.	.	.	(0.99)
β_{MG_M2}	.	0.62	0.58	.	.	.	.	.	.	.
	.	(2.96)	(2.69)	.	.	.	.	.	.	.
β_{MG_NU}	.	.	.	3.58	.	3.59	3.80	.	3.95	4.29
	.	.	.	(3.53)	.	(3.42)	(3.59)	.	(3.71)	(3.85)
β_{MG_U}	.	.	.	.	−0.34	−0.55	.	−0.68	−0.56	−0.31
	.	.	.	.	(−1.57)	(−2.45)	.	(−3.14)	(−2.60)	(−1.32)
Adj. R^2	0.05	0.39	0.53	0.54	0.12	0.61	0.60	0.52	0.61	0.68
	Panel B: Using individual stocks									
β_{MKT}	0.97	1.02	1.00	0.94	1.00	0.93	0.86	0.98	0.87	0.83
	(1.45)	(1.54)	(1.51)	(1.43)	(1.52)	(1.42)	(1.31)	(1.50)	(1.31)	(1.25)
β_{SMB}	.	.	0.03	.	.	.	0.05	0.05	0.05	0.04
	.	.	(0.07)	.	.	.	(0.14)	(0.13)	(0.15)	(0.13)
β_{HML}	.	.	−0.13	.	.	.	−0.17	−0.19	−0.18	−0.18
	.	.	(−0.35)	.	.	.	(−0.47)	(−0.54)	(−0.51)	(−0.51)
β_{LIQ}	−0.91	.	.	.	.	.	.	.	.	−0.83
	(−1.06)	.	.	.	.	.	.	.	.	(−0.97)
β_{MG_M2}	.	0.18	0.20	.	.	.	.	.	.	.
	.	(1.40)	(1.49)	.	.	.	.	.	.	.
β_{MG_NU}	.	.	.	0.92	.	0.91	0.95	.	0.92	0.88
	.	.	.	(1.66)	.	(1.64)	(1.71)	.	(1.66)	(1.59)
β_{MG_U}	.	.	.	.	−0.09	−0.07	.	−0.13	−0.08	−0.09
	.	.	.	.	(−0.75)	(−0.57)	.	(−1.05)	(−0.70)	(−0.75)
Adj. R^2	0.18	0.16	0.18	0.19	0.17	0.19	0.25	0.22	0.25	0.25

Notes: Numbers in parentheses indicate *t*-statistics based on the Shanken (1992) errors-in-variables robust standard errors. The adjusted R^2 is computed by using Equation (4). The sample period is November 2001 to December 2013.

positively priced, regardless of the market factor or FF3 factors plus the (transaction) liquidity factor being controlled. The economic and statistical significance of β_{MG_NU} is maintained whether twenty-five size-BM portfolios, industry portfolios, or individual stocks are used as test assets.[13] However, the explanatory power of the underlying M2 growth beta, β_{MG_U}, for average stock returns is not priced. The risk premium estimate of β_{MG_U} is even negative.[14]

Specifically, when the FF3 factors are controlled (model 9), using twenty-five size-BM portfolios, $\widehat{\gamma}_{MG\_NU}$ (the risk premium estimate of β_{MG_NU}) is 3.95 percent (*t*-statistic of 3.71), while $\widehat{\gamma}_{MG\_U}$ (the risk premium estimate of β_{MG_U}) is −0.56 percent (*t*-statistic of −2.60). When using individual stocks, $\widehat{\gamma}_{MG\_NU}$ is 0.92 percent (*t*-statistic of 1.66), while $\widehat{\gamma}_{MG\_U}$ is −0.08 percent (*t*-statistic of −0.70). Even when the (transaction) liquidity factor, LIQ, is added as a control variable, the results remain qualitatively unchanged. The risk premium estimates of the aggregate M2 growth beta, $\widehat{\widehat{\gamma}}_{MG\_M2}$, are positively significant when using twenty-five size-BM portfolios but are barely significant when using individual stocks. These results indicate that the decomposition of the aggregate M2 into an underlying and a non-underlying M2 provides a much greater explanatory power for the cross-section of stock returns. The risk premium estimates of LIQ are positive but statistically insignificant. Note that we compute *t*-statistics in this article based on the Shanken (1992) errors-in-variables robust standard errors.

Excluding the Mutual Influence of Underlying and Non-Underlying M2 Growth

Underlying and non-underlying M2 growths mutually influence each other. For example, if households' money holdings grow excessively larger than their basic needs for consumption, the excessive amount of money holdings will be used to invest in beneficiary certificates and thus to change the composition of their securities portfolios. This will cause changes in non-underlying M2 growth. Therefore, the previous results in Table 4 for the underlying and non-underlying MG risk factors, MG_NU and MG_U, could be intermingled with each other. To examine the unique pricing ability of each MG risk factor, it is necessary to exclude the mutual influence of the underlying and non-underlying M2 growth.

To do this, we orthogonalize the underlying and non-underlying M2 growth rates by estimating the following vector auto-regressive process with order of three, VAR(3),

$$\mathrm{y}_t = \delta + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \Phi_3 y_{t-3} + e_t \tag{11}$$

where y_t is a 2 × 1 column vector containing the underlying and non-underlying M2 growth rates.[15] We regard the sum of the intercept and residuals from Equation (11) as the orthogonalized underlying and non-underlying M2 growth rates, $g(MG\_U^{\perp})$ and $g(MG\_NU^{\perp})$, respectively. We then obtain the tracking portfolios for the orthogonalized underlying and non-underlying M2 growth, denoted as $MG\_U^{\perp}$ $MG\_NU^{\perp}$, by estimating Equation (1) in which $g(MG\_U^{\perp})$ and $g(MG\_NU^{\perp})$ are used as dependent variables, respectively.

When the orthogonalized MG risk factors ($MG\_U^{\perp}$ and $MG\_NU^{\perp}$) are used instead of the unorthogonalized MG risk factors (MG_U and MG_NU) in the CSR estimation, the results (not reported) show that the orthogonalized non-underlying M2 growth beta, $INF\_U^{\perp}$, is still strongly positively priced, while the orthogonalized underlying M2 growth beta, $\beta_{MG\_U^{\perp}}$, is no longer positively priced, regardless of the market beta or the FF3 factors being controlled.[16] The economic and statistical significance of $\widehat{\widehat{\gamma}}_{MG\_NU^{\perp}}$ remain robust.[17]

After Controlling for Other Macroeconomic Variables

News related to future money growth could also affect other real macroeconomic variables and vice versa. One macroeconomic variable has feedback on the other macroeconomic variables. For example, the central bank controls money supply based on inflation and money supply affects inflation in turn. Underlying and non-underlying MG risk factors may therefore contain information on the pricing ability of the other macroeconomic variables. Based on Chen, Roll, and Ross (1986) and Vassalou (2003), we consider four macroeconomic variables: real growth rate in GDP, real growth rate in industrial production (IP), anticipated inflation rate (INF_A), and unanticipated inflation rate (INF_U).[18] The anticipated and unanticipated inflation rates are obtained by using the Fama and Gibbons (1984) method.

To examine the unique pricing effect of the M2 growth risk factors, we also exclude the mutual influence among the macroeconomic variables. As in the previous section, we regard the sum of the intercept and residuals obtained from estimating the VAR(3) of Equation (11) as orthogonalized macroeconomic variables. In the VAR(3) model, y_t is a (6 × 1) column vector containing the underlying and non-underlying M2 growth rates plus the four macroeconomic variables. For each of the six orthogonalized variables, we then obtain the tracking portfolio by estimating Equation (1) and regard this as the corresponding factor portfolio. We denote the six orthogonalized factor portfolios as $MG\_U^{\perp}$, $MG\_NU^{\perp}$, $GDP^{\perp}$, $IP^{\perp}$, $INF\_A^{\perp}$, and $INF\_U^{\perp}$. Thus, $MG\_U^{\perp}$ and $MG\_NU^{\perp}$ are the factors that capture news about remaining future underlying and non-underlying M2 growth, respectively, after excluding the effects from the other macroeconomic variables.

Table 5 presents the CSR estimation results for the underlying and non-underlying MG risk factors after controlling for the orthogonalized macroeconomic factors. Regardless of whether $\beta_{MG\_NU^{\perp}}$ is alone or is together with the other macroeconomic factor loadings in the model, $\beta_{MG\_NU^{\perp}}$ is all significant in explaining the cross-section of average stock returns. For example, when $\beta_{MG\_NU^{\perp}}$ is in the model with FF3 factors and the four orthogonalized macroeconomic factors (model 7), risk premia estimates of $\beta_{MG\_NU^{\perp}}$, $\widehat{\widehat{\gamma}}_{MG\_NU^{\perp}}$, are 0.57 percent (*t*-statistic of 2.18). Even though the liquidity factor, LIQ, is added in the control variables, its significance remains similar. The risk premium estimate of LIQ is positive and statistically significant (Model 1) but becomes insignificant when MG_NU is added in the model (model 7). Overall, MG_NU has a significant explanatory power for average stock returns even after controlling

Table 5. Cross-sectional regression estimation results using the orthogonalized money growth factors after controlling real macroeconomic variables

Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
β_{MKT}	0.94	−0.55	−1.38	−1.22	1.39	1.07	0.98	1.22
	(0.57)	(−0.26)	(−0.67)	(−0.59)	(0.90)	(0.65)	(0.59)	(0.69)
β_{SMB}	.	.	.	.	0.76	0.77	0.77	0.77
	.	.	.	.	(2.37)	(2.41)	(2.38)	(2.38)
β_{HML}	.	.	.	.	1.01	1.00	1.00	1.02
	.	.	.	.	(3.36)	(3.34)	(3.33)	(3.45)
β_{LIQ}	2.91	.	.	.	.	.	.	1.34
	(2.37)	.	.	.	.	.	.	(0.98)
$\beta_{MG\_NU^{\perp}}$	.	1.20	.	0.87	0.60	.	0.57	0.51
	.	(3.53)	.	(2.97)	(2.27)	.	(2.18)	(1.95)
$\beta_{MG\_U^{\perp}}$	.	.	−0.23	−0.20	.	−0.09	−0.09	−0.10
	.	.	(−2.54)	(−2.18)	.	(−0.96)	(−0.94)	(−1.02)
$\beta_{GDP^{\perp}}$	0.15	0.09	0.11	0.11	0.10	0.10	0.10	0.14
	(1.30)	(0.61)	(0.78)	(0.78)	(0.80)	(0.84)	(0.82)	(1.18)
$\beta_{IP^{\perp}}$	−0.36	−0.05	−0.17	−0.11	−0.15	−0.16	−0.11	−0.05
	(−1.31)	(−0.14)	(−0.56)	(−0.35)	(−0.50)	(−0.51)	(−0.35)	(−0.16)
$\beta_{INF\_A^{\perp}}$	0.03	0.13	0.07	0.10	0.12	0.10	0.11	0.10
	(0.84)	(2.74)	(1.79)	(2.30)	(2.95)	(2.89)	(2.94)	(2.52)
$\beta_{INF\_U^{\perp}}$	−6.59	−169.54	−397.24	−323.61	32.03	−67.21	−66.56	−104.18
	(−0.03)	(−0.51)	(−1.22)	(−1.01)	(0.12)	(−0.23)	(−0.23)	(−0.35)
Adj. R^2	0.39	0.59	0.62	0.65	0.75	0.75	0.76	0.77

Notes: $MG\_NU^{\perp}$ and $MG\_U^{\perp}$ are the risk factors obtained from the economic tracking portfolio approach in which the orthogonalized non-underlying and underlying M2 grow rates are used, respectively. $GDP^{\perp}$, $IP^{\perp}$, $INF\_A^{\perp}$, and $INF\_U^{\perp}$ are the risk factors similarly obtained from the economic tracking portfolio approach based on the orthogonalized variables, respectively. The orthogonalized non-underlying and underlying M2 grow rates are the sum of the intercept and residuals of each variable generated from the VAR(3) model. Test portfolios are twenty-five in size and book-to-market-sorted portfolios. The factor loadings are the predictive betas estimated by rolling over month-by-month the past thirty-six months available up to the estimation month. Numbers in parentheses indicate *t*-statistics based on the Shanken (1992) errors-in-variables robust standard errors. The adjusted R^2 is computed by using Equation (4). The sample period is from November 2001 to December 2013.

for the real macroeconomic factors. However, the explanatory power of factor loadings on the underlying MG risk factor, $\beta_{MG\_U^{\perp}}$, is mostly insignificant or even negatively significant.

The GMM Estimation Results

For cases that the basic assumptions for the regression model estimation are violated (such as dependence of the error terms with the explanatory variables, heteroskedasticity and correlation of the error terms), the previous CSR results could be biased. To confirm the previous results, we perform the GMM estimation which is robust for these cases.

Table 6 reports the GMM estimation results for the cases using the unorthogonalized non-underlying and underlying MG risk factors. The results are overall consistent with those from the CSR estimation (in Table 4). This shows that non-underlying MG betas, β_{MG_NU}, have in general stronger explanatory power for the cross-sectional spread in average stock returns than underlying MG betas (β_{MG_U}) in several performance measures. First, as in the CSR results, non-underlying MG betas have a stronger economic and statistical significance than do underlying MG betas. When both non-underlying and underlying MG betas are in the model with FF3 factors and the liquidity factor (Model 9), their risk premia estimates are 2.59 percent (*t*-statistic of 3.11) and −0.33 percent (*t*-statistic of −1.95), respectively. The aggregate M2_MG betas are insignificantly priced when FF3 factors are controlled. Second, the model including β_{MG_NU} has always a smaller HJ-distance than does the model including β_{MG_U}. The HJ-distance test for the null hypothesis that the squared pricing errors are statistically different from zero rejects all models at the traditional significance level, implying that none of the models considered correctly prices the test assets.[19] Lastly, the models including β_{MG_NU} have always a greater Wald (b) test statistic and a smaller *p*-value than do the models including β_{MG_U}.[20] As in the CSR test (Table 5), the risk premium estimate of LIQ is statistically significant but becomes insignificant when MG_NU is added in the model. This indicates that the non-underlying MG factor subsumes the pricing ability of the liquidity factor.

Conclusions

According to the homogeneity of money holding purpose, the Bank of Korea breaks down aggregate broad money M2 into an underlying and a non-underlying part. This article proposes non-underlying M2 growth as a macroeconomic state variable in the perspective of Merton's (1973) ICAPM, and then examines whether macro liquidity risk related to innovations in the expectation of future non-underlying M2 growth is priced in the Korean stock markets.

Both the CSR and GMM tests show that the risk factor related to innovations in the expectation of future non-underlying M2 growth is significantly positively priced in Korea, regardless of controlling for the mutual influence between underlying and non-underlying M2 growth or for the other macroeconomic variables. These results are obtained after controlling for the well-known factors like the Fama and French (1993) three factors and the transaction liquidity factor. Meanwhile, the risk factor related to innovations in future underlying M2 growth is not priced after controlling for some effects. These results indicate that non-underlying M2 growth plays a much more important role in pricing stocks in Korea and should be more distinctively considered in detecting and managing macro liquidity risk than aggregate M1, aggregate M2 or underlying M2 growth. Therefore, this article provides an important monetary policy implication that a more effective way to manage macro liquidity risk is to control non-underlying M2 growth rather than aggregate or underlying M2 growth.

Table 6. GMM estimation results

Factor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
MKT	–0.80	0.05	–1.18	0.58	–1.49	–0.32	–0.89	–0.76	–0.67	0.95
	(–0.72)	(0.05)	(–1.10)	(0.53)	(–1.36)	(–0.29)	(–0.77)	(–0.72)	(–0.57)	(0.78)
SMB			0.67				0.70	0.60	0.66	0.38
			(1.94)				(2.03)	(2.04)	(1.90)	(1.09)
HML			1.00				1.05	1.13	1.07	0.98
			(3.82)				(3.80)	(3.72)	(3.62)	(3.29)
LIQ	2.08									1.68
	(2.03)									(1.38)
MG_M2		0.38	0.30							
		(2.26)	(1.58)							
MG_NU				2.51		2.14	2.28		1.97	2.59
				(3.63)		(2.89)	(2.63)		(2.32)	(3.11)
MG_U					–0.35	–0.44		–0.40	–0.34	–0.33
					(–2.07)	(–2.66)		(–2.35)	(–1.89)	(–1.95)
J-test	39.24	44.21	37.21	37.51	40.86	31.54	31.30	31.43	29.49	28.20
	[0.013]	[0.003]	[0.011]	[0.021]	[0.009]	[0.065]	[0.051]	[0.050]	[0.059]	[0.059]
Wald(b)	4.1619	10.3857	24.8371	23.1667	6.0221	26.6344	28.9424	25.6859	27.4817	28.0613
	[0.1248]	[0.0056]	[0.0001]	[0.0000]	[0.0492]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0001]
HJ distance	0.7301	0.7319	0.6537	0.7012	0.7408	0.6836	0.6495	0.6518	0.6475	0.6236
	[0.0002]	[0.0001]	[0.0022]	[0.0006]	[0.0000]	[0.0017]	[0.0029]	[0.0022]	[0.0023]	[0.0108]

Notes: Numbers in parentheses indicate t-statistics, and numbers in brackets are p-values.

Notes

1. Chordia, Sarkar, and Subrahmanyam (2005) examine the link between macro liquidity and micro liquidity in bond markets.
2. M1 includes cash with the public, demand deposits other than banker's deposits, and transferable deposits that can be immediately withdrawn into currency without any difficulty.
3. Beneficiary certificates included in M2 consist of stock or equity mutual funds, bond mutual funds, hybrid funds and index funds, all of which are repurchasable before maturity or tradable in the stock market at low transaction costs.
4. Beneficiary certificates are defined in the first section of this article.
5. The procedure for estimating the tracking portfolios using Equation (1) differs from the factor mimicking portfolio approach by Breeden, Gibbons, and Litzenberger (1989). The dependent variable of Equation (1) is the realized future economic variable, while the dependent variable in the Breeden, Gibbons, and Litzenberger (1989) approach is the contemporaneous economic variable. Thus, the economic tracking portfolio approach is designed to capture news about future economic conditions. Control variables, which have the predictive ability for asset returns, are used to estimate the tracking portfolios, while they are not used in the estimation of the factor mimicking portfolio.
6. Chen and Lee (2013) show that default risk has some power to explain stock returns on the Taiwanese stock market.
7. The detailed estimation results are available upon request.
8. The autocorrelation of the non-underlying money growth rate is 0.63 at the one-year lag for the non-overlapping January–December series.
9. Among many, Vassalou (2003) and Kapadia (2011) also set s = tweve months to estimate the tracking portfolio returns for future GDP growth rates and annual failure rates, respectively.
10. All stocks are sorted every month according to the magnitude of the turnover measure of Lesmond (2005) into one of ten decile portfolios. The liquidity factor is obtained by taking a long position in the lowest turnover decile portfolio and a short position in the largest turnover decile portfolio. The turnover measure of Lesmond (2005) is defined as $(1/D_m)\left(\sum_{t=1}^{D_m}\text{volume}_t/\text{shares outstanding}\right)$, where D_m is the number of trading days in the month.
11. To do this, we also form value-weighted portfolios by sorting all sample firms into one of five quintile portfolios according to the magnitude of their money growth (MG) betas which are computed every month based on the previous thirty-six monthly return observations available up to the month. Average returns of β_{MG_M2}- and β_{MG_U}-sorted portfolios appear U-shaped across the portfolios. That is, the small and large MG beta portfolios have greater average returns than do the middle-sized MG beta portfolios. Meanwhile, average returns on β_{MG_NU}-sorted portfolios increase monotonically with the magnitude of β_{MG_NU} from 1.17 percent per month on Portfolio 1 (P1) to 2.40 percent per month on Portfolio 5 (P5) for the sample period from January 2001 to December 2013. These results indicate that β_{MG_NU} has the strongest positive relation with average returns among the three MG betas (not reported). The results are available upon request.
12. Nonetheless, the use of individual stocks as test assets in CSR tests induces the errors-in-variables bias more severe (Kim 1995, 1997).
13. We also estimate the CSR coefficient estimates over business cycles. The risk premium estimates of the non-underlying M2 growth beta, $\widehat{\overline{\gamma}}_{MG\_NU}$, are positive and statistically significant at the traditional significance level over both expansionary and contractionary periods. However, the difference in $\widehat{\overline{\gamma}}_{MG\_NU}$ between expansionary and contractionary periods is statistically insignificant (not reported). The results are available upon request.
14. As a robustness check, we also perform the CSR tests using two different sets of base assets; six value-weighted equity portfolios sorted by size and book-to-market and ten value-weighted industry portfolios. The results are qualitatively similar to those in **Table 4** (not reported). The results are available upon request.
15. We determine the lag of three in the VAR model based on the fitness of the model. We also perform the CSR tests using the orthogonalized results with the lags of one, two, three, four, and five. However, the test results are qualitatively similar.
16. The detailed results are available upon request.
17. We also find that the risk factor associated with money growth in M1 of Jung and Kim (2011) is no longer significantly priced after controlling for the risk factor related to non-underlying M2 growth (not reported). The results are available upon request.
18. We do not include default spread (DEF) and term spread (TERM) in the orthogonalization of the macroeconomic variables, since these two macroeconomic variables are already considered in constructing the tracking portfolios as control variables in Equation (1).
19. The p-value for the null hypothesis is computed based on Kan and Robotti (2009).

20. 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 an important implication for the SDF and have marginal explanatory power for pricing the test portfolios. As a robustness check, we also perform the GMM estimation for the case using the orthogonalized non-underlying and underlying MG risk factors. The results show that the orthogonalized non-underlying MG risk factor is strongly positively priced, while the orthogonalized underlying MG risk factor is insignificantly priced (not reported). The results are available upon request.

Acknowledgments

The authors are grateful to three anonymous referees and the editor, Ali M. Kutan, for very thorough and constructive comments and suggestions. Any errors remain our responsibilities.

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