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Master Thesis [MSc Economics and Business - Financial Economics]

Macroeconomic and Monetary Variables and the Cross Section of Expected Equity Returns

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Abstract

Non-traded factors, in contrast to traded factors, have been grossly neglected in academic literature. Accordingly, this paper studies the potential relationships between macroeconomic and monetary variables to the cross-section of expected US equity returns from January 1973 to May 2021. The two-step Fama-MacBeth procedure is employed to construct the factors and their corresponding risk premiums for the innovations in the labor force participation rate, real personal consumption expenditure, core CPI, the unemployment rate, and the loan-to-deposit ratio. The resulting factor risk premiums for the variables studied were insignificant and these results were robust to a different factor mimicking portfolio construction method and a different sample time frame. Consequently, the results of this paper exemplify the econometric issues that plague the Fama-MacBeth procedure in factor construction and risk premia estimation and lend support to the novel methods developed that address these issues.

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1. Introduction

William Sharpe's (1964) and John Lintner's (1965) Capital Asset Pricing Model (CAPM), the foundational asset pricing model, should capture the relationship between macroeconomic and monetary variables and expected stock returns through the market portfolio given the CAPM's assumptions hold. However, the comprehensive catalogue of extant literature identifying non-market risk factors with significant non-zero risk premia serve as evidence of the failure of the CAPM to fully explain the cross-section of expected stock returns. The failure of the CAPM signifies that the relationship between macroeconomic and monetary variables and expected stock returns is not fully incorporated in the relationship between an asset's return and the market portfolio return, which motivates the exploration of significant macroeconomic and monetary variables that explain the cross-section of expected equity returns.

Asset pricing research has predominantly focused on firm characteristics and traded factors to explain the cross-section of expected returns of stocks as shown in Harvey & Liu's (2019) collection of factors they maintain, where they account for 525 factors of which 445 are traded factors. This disproportionate focus on traded factors and corresponding negligence of non-traded factors, specifically macroeconomic and monetary factors, has culminated in a serious lack of analysis of the potential relationships between expected returns and non-traded factors. As such, the main research question of this paper, which focuses on the United States (US) equity market, is: What macroeconomic and monetary variables significantly explain the cross-section of expected stock returns?

The structure of this paper is as follows: First, a revision of academic literature underpinning asset pricing, macroeconomics, and monetary economics. Further, the hypotheses on the expected relationships between the chosen macroeconomic and monetary variables to incorporate into an asset pricing model and the cross-section of expected stock returns are formulated. Second, the data utilized in this study are disclosed and elaborated upon. Third, the methodology employed to construct the macroeconomic and monetary variables' factor-mimicking portfolios (FMP) and their corresponding risk premiums are described. Fourth, the resulting asset pricing model is discussed and alternative explanations for the results are explored. Fifth, a conclusion on the explanatory power of the chosen macroeconomic variables to describe the cross-section of expected stock returns is drawn, the results' implications on the hypotheses are examined, the robustness of the findings, the limitations, and the contributions to relevant areas of research of the paper are discussed, and further areas of research pertaining to the results are disclosed.

2. Theoretical Framework

A. Modern Portfolio Theory, the CAPM, and Macroeconomic and Monetary Variables

In the Sharpe-Lintner CAPM (Lintner, 1965; Sharpe, 1964), the market portfolio, which contains all assets, should capture the relationship between the cross-section of stocks' expected returns and macroeconomic and monetary variables. The market portfolio only encapsulates this relationship if the CAPM's pivotal assumptions hold. Two integral assumptions of the CAPM are: i) all investors hold the same expectations regarding assets' expected returns and the assets' expected returns covariance matrix and, ii) asset markets are characterized by perfect competition (investors are price-takers, implying if an asset is not held by any investor, its price will drop so that its expected return increases until an investor purchases this asset). If these two assumptions (and the additional assumptions underpinning the CAPM and the underlying assumptions of the mean-variance framework of modern portfolio theory) hold, all investors will hold the same tangency portfolio in solving their investment optimization problem, meaning the tangency portfolio will hold all assets, resulting in the market portfolio. If agents are characterized as rational (i.e., optimize utility of consumption with respect to the weight allocated towards risky assets, i.e., those assets with stochastic payoffs), the relationship between the marginal utility of consumption and the expected return on the market portfolio is perfectly negatively correlated, a key assumption (alongside the assumption of a quadratic utility function or normally distributed returns) in deriving the Sharpe-Lintner CAPM from the consumption CAPM (Breeden, 1979; Cochrane, 2009; Lucas, 1978; Merton 1973; Rubinstein, 1976).

However, the assumptions of the CAPM and the mean-variance framework of Markowitz (1952), which serves as the CAPM's foundation, such as normally distributed returns or a quadratic utility function, homogenous expectations on assets' mean returns and the covariance matrix of all assets' returns, etc., are both restrictive and practically inapplicable, meaning that the market portfolio will not contain every asset and will not encapsulate all potential relationships that explain assets' expected returns (Berk, 1997; Fama & French, 2004; Samuelson, 1970). This means the relationship between marginal utility of consumption and the market portfolio's expected return will not be perfect (as the market portfolio return should have a perfect negative correlation to marginal utility of consumption as there is nothing else to invest in if the market portfolio holds all assets and increases in the market portfolio return will subsequently decrease the marginal utility of consumption for agents). Thus, the market portfolio will not adequately represent the relationship between assets' expected returns and macroeconomic and monetary variables. Further, the mere existence of risk factors other than the market portfolio that can significantly explain the cross-section of expected returns is evidence of the inadequacy of the market portfolio and the CAPM to capture all relevant relationships to expected stock returns. Foundational papers in asset pricing such as Fama and French (1992, 1993, 2015) and Carhart (1997) are evidence of the CAPM's inadequacy in explaining the cross-section of expected stock returns.

B. Output, an Economy's Production function, and Aggregate Demand and Supply

Central to the analysis of the relationship between macroeconomic and monetary variables to the cross-section of expected equity returns is the relationship between the market value of an equity share and the expected cash flows of the equity share. Algebraically, the market value of an equity share can be shown as such:

$$P_t = \sum_{s=t}^{T} \frac{E_t[Y_s * \delta_s]}{(1 + R_e)^{s-t}}$$

Where P_t is the per share stock price, Y_s is the net income, δ_s is the payout ratio which is the percentage of net income paid out as dividends, and R_e is the long-term average expected stock return or internal rate of return that equates the expected dividends (net income times payout ratio) to the current market price of the stock price (Fama & French, 2015). Aggregate corporate profits can be said to be the pre-tax net income generated by economic output. This is because the gross domestic income (GDI) of a country should be equivalent to its gross domestic product (GDP). As such, corporate profits are the residual income earned by firms, net employee compensation. In other words, aggregate corporate net incomes represent the portion of total income earned from current production by U.S. corporations (BEA, 2017). Thus, keeping the stock price constant, as economic output grows, corporate profits and earnings per share increase, and the expected equity return rises. The rationale for this order of effects is as such: increases in aggregate demand, which is the total amount of output demanded (which is equivalent to planned expenditure, which is the total amount that households, firms, government, and foreigners (households, government, etc.) want to spend on domestically produced goods and services), correspond to increases in real aggregate output such that the goods markets are in equilibrium (Mishkin, 2019). Thus, growing real economic output, which is indicative of rising aggregate demand, corresponds with rising corporate profits, as on average, companies' revenues rise while increases in labor costs, which represent a significant component of companies' cost structures (from the first quarter of 1947 to the third quarter of 2021, employee compensation represented on average over 55 percent of GDI (U.S. Bureau of Economic Analysis, 2022)), lag revenue growth as wages are sticky due to their contractual nature and other non-Walrasian features of labor markets that inhibit complete real-wage adjustments in response to output variation, i.e., labor markets are unable to clear (Sbordone, 2002; Taylor, 1980). This results in expanding operating margins, higher pre-tax profits, and increases in net income and correspondingly earnings per share, leading to increases in the expected equity return given equity prices remain constant. Conversely, as stipulated by Chen et al. (1986), the discount rate for equity cash flows, i.e., the expected equity return, varies with the risk-free rate which serves as a benchmark rate of return. Changes in the risk-free rate leads to proportional (positive) changes in the discount rate of equity cash flows, i.e., the expected equity return, which decreases the present value of future equity cash flows and correspondingly leads to a negative realized return, ceteris paribus. Therefore, determinants of the risk-free rate fundamentally affect the expected equity return. The goal of monetary policy with a mandate of inflation targeting and full employment is to achieve a real interest rate which is consistent with the natural interest rate, which is the real interest rate that equates real economic output to potential output and congruently neither imposes upward or downward inflationary pressures (Lane, 2019; Wicksell, 1936; Laubach & Williams, 2003). Determinants of the risk-free rate thus will correspond to the determinants of the natural interest rate, which are potential output growth (which is determined by labor growth, capital accumulation (which is determined by the economy's savings rate)), total factor productivity growth (efficiency gains or technological progress), and the inflation target (Holston et al., 2017; International Monetary Fund. Research Dept, 2015; Laubach & Williams, 2015). The relationship between the discount rate and equity cash flows to anticipated equity return can be shown by the actual return earned in any period (for simplicity, assume equity cash flows do not grow, allowing one to express the present price of an equity share as the perpetuity of the dividend scaled by the long-term average expected stock return):

$$\frac{dP}{P} + \frac{d(Y * \delta)}{P} = \frac{d(Y * \delta)}{(Y * \delta)} - \frac{dR_e}{R_e} + \frac{d(Y * \delta)}{P}$$

Thus, holding all other variables constant other than P and R_e, an increase in the required return on equity, i.e., the expected equity return, will lead to a negative realized return, as a rising expected equity return is synonymous with increased riskiness of the expected cash flows, vice versa. Conversely, growth in equity earnings leads to a positive realized return, ceteris paribus. Keeping the price of a stock constant, firms with cashflows that positively covary with the growth of economic and monetary variables like output, consumption, investment, labor, velocity of money, etc., will then have higher expected rates of return to compensate for the cyclicality of their cashflows.

An economy's production capacity can be described by a Cobb-Douglas production function:

$$Y = K^{\alpha}(AL)^{(1-\alpha)} \qquad where\ 0 < \alpha < 1$$

where K and L represent an economy's production factors (physical) capital and labor (number of labor hours worked), respectively, A represents technology or total factor productivity (efficiency), and α represents the output elasticity to capital (percentage change in output given a percentage change in the capital employed in the production of output). Potential output growth, the growth in real economic output or real GDP attainable at full employment (only structural or frictional unemployment remains), is determined by three factors: labor growth, capital accumulation (which is determined by the economy's savings rate (public and private saving)), and total factor productivity growth (technological progress) (International Monetary Fund. Research Dept, 2015). As such, the growth dynamics of labor, physical capital, and total factor productivity play a pivotal role in the growth of corporate earnings and consequently expected stock returns.

C. Labor Force Participation Rate

A metric that signals organic labor force growth is the labor force participation rate, which is the ratio of the labor force (those currently working and unemployed persons actively seeking employment) over the total civilian working-age population (civilians aged 16 and over) (U.S. Bureau of Labor Statistics, n.d.). A high ratio indicates a large proportion of the population that can work are working or are actively seeking work. As such, increases in the labor force participation rate are indicative of increases in the overall labor force and in the labor hours employable for production, which leads to the productive capacity of an economy to grow by the marginal productivity of labor and correspondingly corporate profits and expected equity returns rise. Thus, the labor force participation factor will command a positive risk premium in explaining the cross-section of expected stock returns as stocks that load positively on the labor force participation rate factor will positively covary with economic output, thus leading to procyclicality in expected earnings of a firm prompting investors to demand a higher expected return as those stocks' expected returns will positively covary with expected consumption.

D. Inflation

Inflation is a primary determinant of the risk-free rate (and thus the natural interest rate) due to the Federal Reserves' dual mandate monetary policy of price stability and full employment. The Federal Reserve achieves price stability through inflation-targeting, where they control the supply of reserves held by depository institutions to achieve the desired level of their policy rate, the federal funds rate, through open market operations (the dominant monetary policy tool used by the Federal Reserve), which is the purchasing or selling of securities by the Federal Reserve, leading to corresponding increases or declines in depository institutions' reserves held at the Federal Reserve (Board of Governors of the Federal Reserve System, 2021). Following the Taylor rule and the concept of a natural interest rate, increases (decreases) in inflation above (below) the target inflation rate are matched with increases (decreases) in the real interest rate greater than the increase (decrease) in inflation as a monetary policy stabilization tool. Thus, increases in inflation lead to increases in the risk-free rate, which decreases the present value of the equity cashflows, ultimately leading to a negative realized return, holding all other variables constant. Therefore, increases in inflation will negatively influence the cross-section of expected equity returns, implying the inflation factor will command a negative risk premium. To further rationalize this hypothesis, increases in the real interest (risk-free) rate lead to a decrease in investment spending by firms, as it becomes more costly for firms to borrow and to fund projects which are benchmarked against higher required rates of return (assuming a principal determinant for hurdle rates in capital budgeting is the real risk-free rate), i.e., investments into physical capital become more costly in terms of opportunity cost (the rate that could have been earned by investing in financial securities such as bonds and stocks) (Mishkin, 2019). Lower investment spending by firms brought upon by higher real interest rates to counteract an increase in inflation above the inflation target leads to lower aggregate demand and thus a fall in real economic output. While holding the price of a stock constant, this leads to lower aggregate corporate profits and a decline in the expected equity return or equity discount rate.

E. Unemployment

Full employment, the second component of the Federal Reserve's dual mandate monetary policy, corresponds to a policy target of achieving and maintaining an actual unemployment rate equivalent to the natural rate of unemployment, or equivalently, real economic output equivalent to potential output. The natural rate of unemployment is an unemployment level that only consists of structural and frictional unemployment (Mishkin, 2019). An economy that has an unemployment rate equal to the natural rate of unemployment is equivalent to an economy operating at its potential level of output. As such, increases in the unemployment rate would lead to a decline in real economic output (equal to the marginal productivity of labor), which decreases corporate profits and leads to a decline in the cross-section of expected equity returns. Unemployment as a factor would thus command a negative risk premium, as stocks' whose excess returns load positively to the unemployment factor implies the stocks' cashflows are counter-cyclical to (or negatively covary with) economic growth. As such, the expected equity returns on stocks that have a positive sensitivity to unemployment would be lower as they act as insurance against economic shocks.

F. Consumption

Consumption represents a significant component of US aggregate demand, which therefore implies consumption is a principal determinant of US real economic output (if goods markets are to be in equilibrium). From the first quarter of 1947, when data on GDP and its underlying components started to be collected in quarterly intervals rather than annual intervals, to the third quarter of 2021, the average ratio of personal consumption expenditure (PCE) (household spending on durable and non-durable goods and services) to GDP was 63.5% (U.S. Bureau of Economic Analysis, 2021). As such, one can anticipate that variation in consumption (growth) leads to directly positive proportional variation in GDP (growth). Due to the relationship between corporate profits and GDP, variation in real personal consumption expenditure growth, which is adjusted for inflation, corresponds to proportional variation in (real) output growth and corporate profits, which will lead to significant variation in the cross-section of expected equity returns. Thus, increases in real personal consumption expenditure growth correspond to an increase in aggregate demand, which leads to an increase in economic activity, which subsequently leads to rising corporate profits and correspondingly higher expected equity returns in the cross-section. Hence, real personal consumption expenditure will command a positive risk premium. From a risk perspective, firms' returns that have a positive sensitivity (positive beta or loading) to the real personal consumption expenditure factor will have an aspect of procyclicality to their cash flows with respect to economic output, and as such, investors require a positive risk premium and thus a higher expected return on those stocks. Investors will require a higher expected return for stocks with a positive loading to the real personal consumption expenditure factor as utility of consumption and the returns on such stocks will positively covary implying low or negative returns when marginal utility of consumption is relatively higher owing to lower consumption.

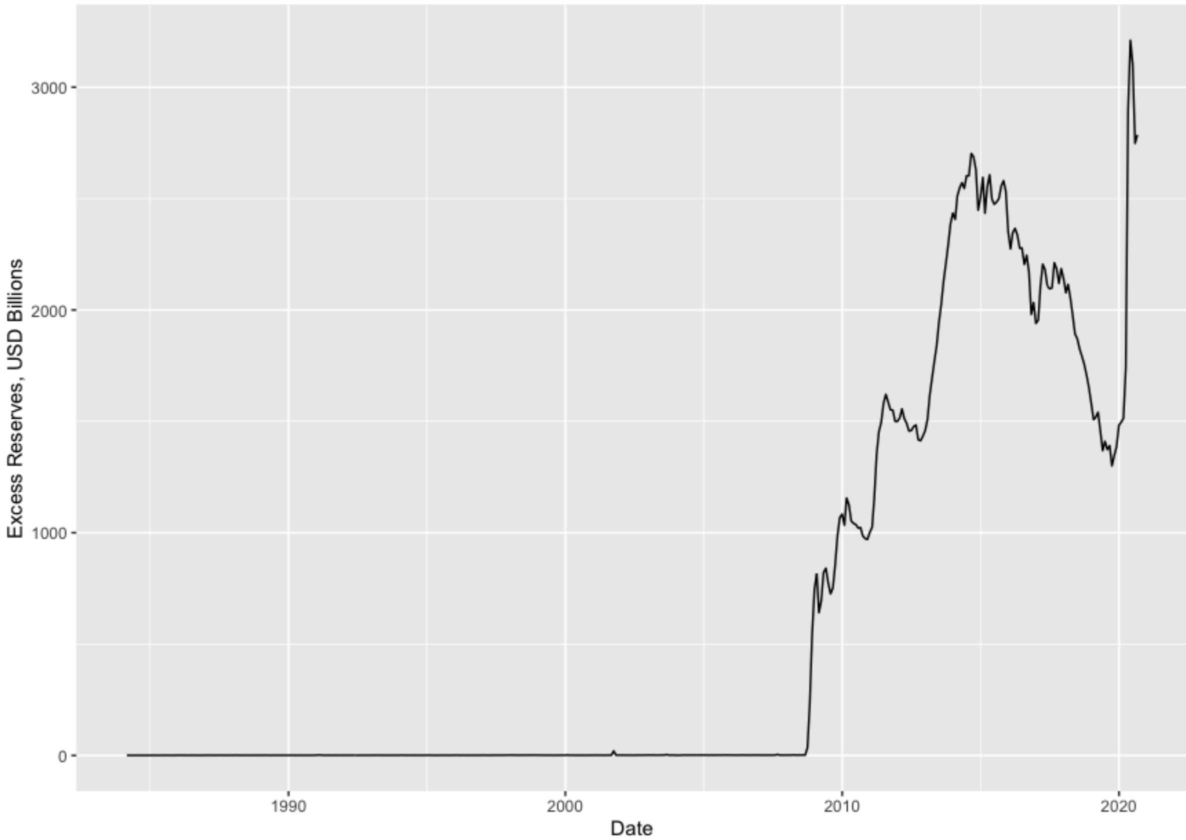
G. Money Supply, Velocity of Money, Money Multiplier, Marginal Revenue Product of Debt, and Loan-to-Deposit Ratio

i. Money Supply

The relationship between the money supply and the cross-section of expected equity returns has recently become highly contentious due to the Federal Reserve's accommodative monetary policy in the form of quantitative easing (large asset purchase programs in credit markets deemed key to the well-functioning of the flow of credit such as asset-backed security markets, the Treasury market, etc.) which lasted more than a decade, specifically from the Global Financial Crisis of 2008 to March 2022, when the Federal Reserve announced a policy rate hike, the commencement of rolling back large asset purchase programs and the initiation of quantitative tightening, and the commitment to a campaign of policy rate hikes to fend off inflation spiral risk (Board of Governors of the Federal Reserve System, 2022). The equation of exchange, an established theory in monetary economics, suggests that increases in the supply of money should result in proportional increases in the aggregate price level in the economy, given real economic output and velocity of money are unchanged or constant (Fisher, 1911). However, given that neither the velocity of money (as seen in Figure 2) or the level of real economic output is constant, the exponential increase in the money supply (M1 and M2 money supply) and the related fall in the velocity of money as proxied by a falling loan-to-deposit ratio has led to tremendous amounts of the increase in high-powered money (monetary base) brought upon by the Federal Reserve through accommodative monetary policy being held by depository institutions as excess reserves (see Figure 1) or being used to purchase financial securities as opposed to being originated into private loans (as indicated by a lower loan-to-deposit ratio). As quantitative easing has become the main monetary policy tool of the Federal Reserve after the Global Financial Crisis of 2008, increases in the monetary base by the Federal Reserve, by buying financial securities held by depository institutions which in turn increases their holdings of non-borrowed reserves, combined with a falling velocity of money prompted by an increase in excess reserves held by banks (which leads to a decline in the loan-to-deposit ratio), stunts multiple deposit creation and thereby reduces the money multiplier. As such, increases in the monetary base (equivalent to a lowering of the policy rate in a non-zero-interest rate environment) are not loaned out to their most productive uses as signified by a lower loan-to-deposit ratio, meaning the net effect of such increases in the monetary base are expanding corporate valuation multiples not driven by increases in aggregate firm profitability (this would be the case if the loan-to-deposit ratio increased following an increase in the monetary base leading to (potential) GDP growth), which in turn decreases the expected return on equity (Kunz, 2020). This contrasts with the anticipated relationship between money supply growth and the cross-section of expected equity returns, where holding the aggregate price level and velocity of money constant, increases in the money supply are indicative of real economic output growth, leading to growth in aggregate corporate profits and a higher expected equity return. As such, money supply growth would command a positive risk premium, however given the decade-long distortion in the relationship between money supply growth and economic output growth as described above, its significance would be weak at best.

Figure 1.

Ballooning of Excess Reserves held by US Depository Institutions



Note. Time series from 1984-02-04 to 2020-08-01 of weekly data of excess reserves held by depository institutions aggregated to a monthly frequency using the average aggregation method. Data are from the Federal Reserve Bank of St. Louis Research website.

ii. Money Multiplier

A monetary concept related to the velocity of money is the money multiplier. Increases in the money supply are dictated by the money multiplier. The money multiplier can be algebraically expressed as such:

$$MB = C + R$$
$$R = RR + ER$$
$$er = \frac{ER}{D}; c = \frac{C}{D}$$
$$RR = rr * D \,; ER = er * D$$
$$MB = (c + rr + er) * D$$
$$MS = C + D = c * D + D = (1 + c) * D$$
$$MS = \frac{1 + c}{c + rr + er} * MB$$

Where MB is the monetary base, C is the total currency in circulation, R is the total amount of reserves held by depository institutions, RR is the total amount of required reserves, ER is the total amount of excess reserves, D is the total amount of deposits held at depository institutions, and MS is the money supply. As velocity of money dictates how many times on average a dollar is spent to purchase the total amount of output produced over a period, declines in the velocity of money imply increases in the monetary base (sum of currency and reserves in the monetary system) will lead to declining increases in money supply. This is because of the negative relationship between the velocity of money and excess reserves in the banking system, or conversely, the positive relationship between the money multiplier and the velocity of money. A falling velocity of money is indicative that depository institutions are unable to efficiently propagate the process of multiple deposit creation. As such, increases in the money multiplier are indicative of depository institutions fulfilling their role in the multiple deposit creation process, thereby increasing economic output (by extending private loans to those with the most productive uses for these funds), aggregate firm profits, and the expected equity returns. This suggests that the money multiplier factor would command a positive risk premium in explaining the cross-section of expected equity returns.

iii. Velocity of Money

The quantity theory of money is a cornerstone theory in monetary economics. A foundational equation in monetary economics that expresses the quantity theory of money is Fisher's equation of exchange (1911). The equation of exchange postulates that increases (declines) in the supply of money leads to proportional increases (declines) in the price level in an economy, given the velocity of money and real economic output are stable. However, the velocity of money, the average number of times a dollar is used over a period to purchase the amount of total output in an economy, is not stable but negatively related to money demand. This can be shown by assuming equilibrium in money markets, where the supply of money is equal to the demand of money, and reformulating the equation of exchange as follows:

$$M\ x\ V = P * Y$$

$$V = \frac{P * Y}{M}$$

$$M^d = L(i, Y)\ \ and\ M^D = M^S$$

$$V = \frac{P * Y}{L(i, Y)}$$

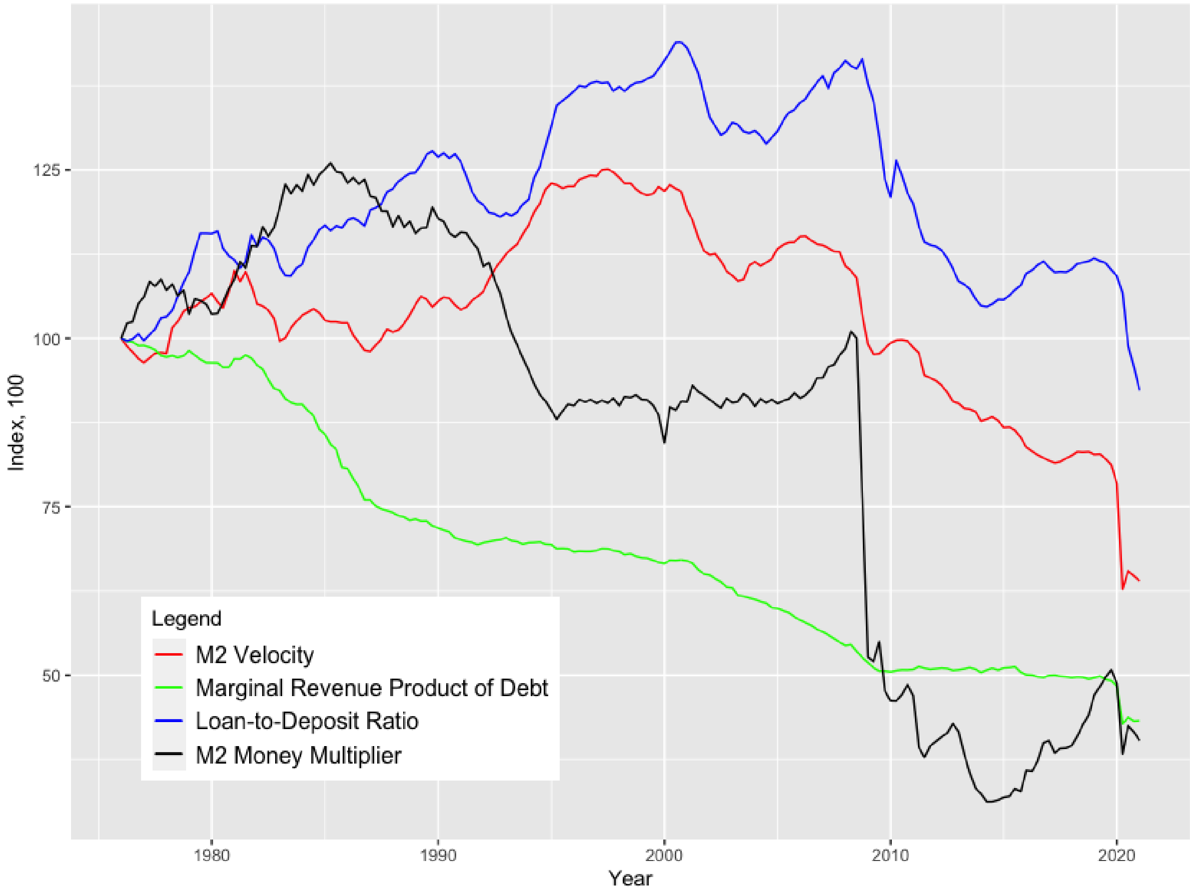
Where M^d is the demand for money, M and M^S represent the supply of money (which is exogenously determined by the central bank), V is the velocity of money, P is the price level of the economy, Y is real economic output, and i is the nominal interest rate. As theorized in John Maynard Keynes' liquidity preference theory, the demand for (real) money (balances) is inversely related to nominal interest rates (Keynes, 2018). As nominal interest rates rise, the opportunity cost of holding cash (earning the interest rate) grows, leading to lower demand for money. Conversely, money demand and real economic output are positively related. As real economic output (and correspondingly household incomes) grows, the demand for money rises as one requires more money to perform more transactions (Tobin, 1958). Variation in the velocity of money commands a positive risk premium in the cross-section of expected equity returns due to its relationship to nominal output in the equation of exchange. As velocity declines, nominal output declines, ceteris paribus. Intuitively, velocity of money is indicative of the productiveness of the supply of money as it shows how many times the available supply of money is spent to purchase nominal output. Holding aggregate price levels and the money supply constant, increases in the velocity of money lead to proportional increases in real economic output. As such, increases in the velocity of money should correspond with increases in expected equity returns in the cross-section, vice versa, and correspondingly would carry a positive risk premium.

iv. Loan-to-deposit Ratio

An important determinant of the velocity of money, the money multiplier, and the money supply is the loan-to-deposit ratio, which is the ratio of the total loans and leases held by depository institutions to the total amount of deposits held at depository institutions (Hoisington Investment Management Company, 2021a). The loan-to-deposit ratio indicates the ability of depository institutions to convert their liabilities (deposits) into interest-bearing loans, which in turn incites the process of multiple deposit creation. In highly indebted countries, which Ilzetzki et al. (2013) defined as countries with central government having outstanding debt exceeding 60% of their GDP, a declining loan-to-deposit ratio can be explained by a multitude of factors, however, the principal determinants for a falling loan-to-deposit ratio are two-fold: First, a declining marginal revenue product of debt (MRPD), which is the additional output attained from an additional dollar of debt, implies that increases in debt increase the risk of default, which increases the risk premium and corresponding rates depository institutions charge on loans they extend. This line of reasoning is as follows: incurring additional debt when debt loads are extremely high increases the absolute level of debt service (interest) payments debtors need to pay. As there are diminishing marginal returns to the use of debt in highly indebted countries, as shown by a falling marginal revenue product of debt, the corresponding incremental growth in income has a higher probability of being lower than the increased amount of interest payments payable from taking on more debt. As such, the probability of default by borrowers increases. Second, as the probability of default rises, this raises risk premiums, which leads to increases to the interest rates charged on loans extended by depository institutions. However, if depository institutions are unable to pass on this increase in risk premium through higher interest rates charged on risky loans, depository institutions would become increasingly reluctant or even unwilling to make private loans to households, firms, etc., due to their inability to pass on rising risk premiums as a result of rising credit risk onto borrowers through higher interest rates charged on loans as this would further increase the probability of default. Due to this reluctance to extend private loans by depository institutions, the fall in the loan-to-deposit ratio is consistent with more deposits held at depository institutions being directed to the purchase of public sector assets, e.g., Federal securities, where the money multiplier for bank investments in financial securities is lower than that of bank loans, rather than being originated into private loans which spur the process of multiple deposit creation, thus putting downward pressure on the money multiplier and velocity of money. As such, in highly indebted countries, an increase in the monetary base through open market operations in conjunction with the unwillingness of depository institutions to extend private sector loans due to a declining marginal revenue product of debt, would lead to a decline in the loan-to-deposit ratio and to a corresponding decline in the velocity of money. Consistent with a fall in the velocity of money and loan-to-deposit ratio in the face of an increase of the monetary base is an increase in the total amount of excess reserves held by depository institutions, which decreases the money multiplier and thus leads to lower increases in the money supply. Excess reserves represent readily available capital which depository institutions could lend out and prompt the process of multiple deposit creation, which in turn increases the money multiplier and subsequently the money supply and economic output, given these loans are allocated to their most productive uses. Due to the loan-to-deposit ratio encapsulating the relationships between the velocity of money, the money multiplier, and the money supply (see Figure 2), it is used as a proxy for these monetary variables in explaining the cross-section of expected equity returns (Hoisington Investment Management Company, 2021a; Hoisington Investment Management Company, 2021b). Thus, in countries that are not highly indebted, growth in the loan-to-deposit ratio is indicative of rising velocity of money, meaning each additional dollar of money produces more GDP which increases aggregate profits and accordingly leads to a higher expected equity return as an increasing share of deposits are allocated to private loans which have a higher money multiplier as they are more productive than depository institutions' investments into financial securities (Hoisington Investment Management Company, 2021b). The loan-to-deposit factor as a result would command a positive risk premium as firms' excess returns that load positively on this factor would carry systemic procyclical risk to economic output.

Figure 2.

The systemic decline in the loan-to-deposit ratio, velocity of money, the money multiplier, and the marginal revenue product of debt.



Note. Quarterly time series from December 1975 to December 2020 of M2 velocity of money, the marginal revenue product of debt, the loan-to-deposit ratio, and the M2 money multiplier indexed time series to 100 in December 1975. All data presented in the figure were retrieved from the Federal Reserve St. Louis Research website.

3. Data

A. Stock return data

The monthly stock return data is obtained from the Center for Research in Security Prices, or otherwise known as CRSP. The sample data of monthly stock returns ranges from January 1973 to May 2021, which amounts to 581 months. Following previous literature, specifically Pukthuanthong et al. (2019), stocks with a price less than $1 or a market capitalization less than $6 million are excluded. Additionally, stocks with less than 60 consecutive months of data are excluded. These exclusions and accounting for delisted returns to avoid survivorship bias by utilizing the methodology by Bali et al. (2016) results in a sample of monthly stock returns containing 11,341 stocks, with 2,021,832 observations in total (Beaver et al., 2007). On average there are 3,480 stocks each month in the sample. The mean monthly return earned in excess of the risk-free rate, the 1-month T-Bill yield, is 1.278%, whereas the median monthly excess return is minus 24.3 basis points or -0.243%. Table 1 shows the summary statistics for the firms, risk-free rate, and stocks' excess returns in the sample.

Table 1. Summary statistics of the stock returns

	Firms	**RF**	**ret**	**Months**
Mean	3479	0.391	1.278	
Median	3564	0.4	-0.243	
Std. Dev.	614.221	0.282	17.429	
N. Obs.	11341	581	2021832	581

Note. RF is the one-month T-Bill rate and ret is the monthly stock excess return, which are both in percentages.

B. Explanatory variables

The non-traded factors used consist of four macroeconomic variables and one monetary variable. The macroeconomic variables used are the labor force participation rate (LFP), real personal consumption expenditure (PCE), core consumer price index (INFL), and the unemployment rate (UNRATE). Monthly time series for the labor force participation rate, core consumer price index, and the unemployment rate are obtained from the Federal Reserve St. Louis Research website. The monthly time series for real personal consumption expenditure is retrieved from the U.S. Bureau of Economic Analysis. Data for the monetary variable, the loan-to-deposit ratio (LDR), are also obtained from the Federal Reserve St. Louis Research website. The loan-to-deposit ratio consists of two monthly time series: the numerator of the ratio is the monthly time series of the total loans and leases in bank credit of all commercial banks. Importantly, this time series was initially in a weekly frequency, and as such was aggregated to a monthly frequency using the averaging aggregation method available on the Federal Reserve St. Louis Research website. The denominator of the ratio is the monthly time series of the deposits of all commercial banks. Similarly, this time series was initially available in a weekly frequency which was then aggregated using the same approach used for the total loans and leases in bank credit of all commercial banks. Consistent with Chen et al. (1986), innovations of the economic variables are estimated as first differences, i.e., realized month-to-month growth rates. In other words, innovations are calculated by taking the difference in the logs of the factor between the current and previous month.

Table 2. Summary statistics of the explanatory variables in percentages

	LFP	**PCE**	**INFL**	**UNRATE**	**LDR**
Mean	0.004	0.279	0.314	0.283	-0.017
Median	0.000	0.237	0.267	0.000	0.010
Std. Dev.	0.290	1.090	0.296	10.336	0.704

Note. LFP is the monthly time series innovation in the labor force participation rate, PCE is the monthly time series innovation in real personal consumption expenditure, INFL is the monthly time series innovation in core CPI, UNRATE is the monthly time series innovation in the unemployment rate, LDR is the monthly time series innovation in the loan-to-deposit ratio.

Table 3. Correlation matrix for explanatory variables

	LFP	**PCE**	**INFL**	**UNRATE**
PCE	0.384			
INFL	0.108	-0.015		
UNRATE	-0.172	-0.291	0.009	
LDR	0.108	0.085	0.112	-0.108

Note. LFP is the monthly time series innovation in the labor force participation rate, PCE is the monthly time series innovation in real personal consumption expenditure, INFL is the monthly time series innovation in core CPI, UNRATE is the monthly time series innovation in the unemployment rate, LDR is the monthly time series innovation in the loan-to-deposit ratio.

Table 3 shows the correlation matrix for the explanatory variables. Monthly growth rates of real personal consumption expenditure and labor force participation rate are positively correlated. This is expected due to the positive relationship between real personal consumption expenditure and the labor force participation rate, as growth in real personal consumption expenditure increases the aggregate demand for total output of final goods and services which prompts firms to increase output and thus hire more labor (assuming effective labor demand) to meet the increased demand. Furthermore, the unemployment rate is negatively correlated to personal consumption expenditures, which is anticipated as falls in aggregate demand through lower consumption lead to declines in economic output as the unemployment rate increases. The correlations between the other explanatory variables are negligible. In sum, of the variables of interest, no variable is perfectly correlated to another implying that no factor is replaceable by another.

4. Methodology

Estimating FMPs and their corresponding risk premiums is straight-forward for traded factors or firm-characteristic factors: one can simply determine all assets' time-series betas to the latent factor, rank them according to pre-determined breakpoints, e.g., deciles, and control for other factors (sorted portfolios), go long the top and short the bottom breakpoint portfolio of assets, which results in the FMP, and the resulting return of the net-zero investment portfolio (FMP) is the risk premium for that factor. A key issue when attempting to construct FMPs and risk premia for macroeconomic and monetary factors is that the factors will not vary cross-sectionally, i.e., across assets. As such, in constructing and estimating FMPs and their corresponding risk premia the cross-sectional method is employed, specifically, the two-step Fama-MacBeth (1973) procedure. In the first step, each asset's excess returns are regressed on all factors to create their time-series factor loadings, or namely, the FMPs. In the second step, for each month in the sample a cross-sectional regression of the cross-section's excess return on the time-series factor loadings is performed to estimate the risk premium for each month, where in the cross-section firms are weighted based on their 1-month lagged market capitalization. Correspondingly, the time-series average of the coefficients of the time-series factor loadings resulting from the second step (cross-sectional regression each month) represents the factor's risk premium for the entire sample period. The methodology can be described formulaically as such:

$$r_i = \alpha_i + \beta_{i,1} f_{i,1} + \varepsilon_i$$
$$r_{t+1} = \alpha_t + \gamma_{1,t} \beta_{1,t} + \varepsilon_{t+1}$$

Where subscripts i and t denote the specific asset and time-period, respectively, r is the excess return, α is the intercept, which can be interpreted as the mispriced component or unexplained return in an asset pricing model, β is the time-series factor loading or beta, f is the factor, ε is the error term, and γ represents the risk premium for the corresponding factor. After conducting the Fama-MacBeth regressions, univariate t-tests for each of the resulting factor risk premia are conducted to determine whether they significantly differ from zero. If the factor risk premium significantly differs from zero, this means that the factor commands a significant non-zero risk premium and that the factor explains the cross-section of expected equity returns through assets' beta or loading to the factor.

5. Results

Table 4 shows the results of the univariate t-tests on the resulting factor risk premiums, which are the time-series averages of the coefficients to the time-series factor loadings determined in the first step of the two-step Fama-MacBeth procedure. The intercept, or conversely the unexplained return component is significant at the 1% level, implying that the factors and their corresponding risk premiums fail to fully explain the cross-section of the expected equity returns. Table 4 shows that none of the factors and their risk premiums are significant. Table 5 shows the results for the univariate specifications of the Fama-MacBeth regressions using only individual factors which are consistent with the multivariate specification where all the factor risk premiums' signs are the same except for unemployment rate. Despite the uniform insignificance of the factors owing to the limitations of the Fama-MacBeth procedure employed, the signs of the factor risk premiums can be interpreted cautiously. The labor force participation rate and real personal consumption expenditure factors' risk premiums contain the expected signs. The labor force participation rate and real personal consumption expenditure factors' risk premiums being positive is consistent with what was anticipated due to the positive relationship between an increase in labor force participation rate and real personal consumption expenditure to economic output and therefore, subsequently aggregate profitability and expected equity return. Interestingly, the loan-to-deposit ratio factor risk premium carries the opposite sign than what was conjectured. A possible explanation for this outcome is the breaking down of the expected relationship between the loan-to-deposit ratio and the cross-section of expected equity returns, due to the US becoming highly indebted. Consequently, as outlined in Section 2, increases in the monetary base through open market operations by the Federal Reserve combined with a declining marginal revenue product of debt would lead to a decline in the loan-to-deposit ratio resulting in an increased share of deposits being directed to the purchase of financial securities. Thus, depository institutions' investments into financial securities, i.e., Treasury bonds, would push the prices of equity shares up due to a lower risk-free rate (due to increased demand which pushes Treasury bonds' prices up and yields lowers), resulting in a lowering of the expected equity return assuming expected aggregate profits remain relatively unchanged (one could assume this due to diminishing marginal returns of debt which lower the marginal revenue product of debt, the loan-to-deposit ratio, and the velocity of demand, implying increases in the monetary base and conversely the money supply lead to increasingly lower incremental increases in economic output or GDP), which could explain the negative risk premium (Hoisington Investment Management Company, 2021b). A potential explanation for the lack of significance of the factors' risk premiums is factor contamination, which arises from the combination of measurement error in the underlying factors studied and the factors being correlated to each other (Pukthuanthong et al., 2019). Including factors that are correlated to each other and contain measurement error, such as real personal consumption expenditure and labor force participation rate, in the first step of the Fama-MacBeth procedure (multivariate time-series regression of each firm's excess returns on factor innovations) leads to factor contamination. This means the time-series loading estimated (the FMP) is a linear combination of the underlying factor and the factors it is correlated to, and the factor risk premium associated with the time-series factor loading or FMP will also be contaminated. As such, factor contamination could be a likely explanation for the insignificance of the real personal consumption expenditure, labor force participation rate, and unemployment rate factors' risk premiums as real personal consumption expenditure is moderately positively and negatively correlated to the labor force participation rate and the unemployment rate, respectively, and the underlying factors likely contain measurement errors, leading to an FMP and risk premium that reflects both factors. Accordingly, Pukthuanthong et al. (2019) prescribe the remedy for factor contamination as constructing FMPs for factors independently, where in the context of the methodology utilized in this paper would be estimating time-series factor loadings in individual time-series regression of excess returns on individual factors. Additionally, Fama-MacBeth regressions and the use of the time-series factor loadings, which are estimated with uncertainty, as FMPs in the cross-sectional regressions to estimate the factor premiums introduces two issues: errors-in-variables bias, which leads to the overestimation of factor risk premiums, and assuming that a stock has a constant beta over time (Kim, 1995**)**.

Table 4. Univariate t-test results on factor risk premiums estimated in multivariate Fama-MacBeth cross-sectional regressions over 1973-2021

	Constant		**LFP**	**PCE**	**INFL**	**UNRATE**	**LDR**
Mean	1.168		0.004	0.017	0.009	0.138	-0.023
Std. Err.	0.247		0.010	0.028	0.009	0.199	0.031
t-statistic	4.726	***	0.466	0.596	1.009	0.693	-0.735

Note. In the cross-sectional regressions stocks are weighted based on their 1-month lagged market capitalization. Standard errors and t-statistics are estimated with a Newey-West adjustment with a lag of 6 months.

*p<0.10, **p<0.05, ***p<0.001.

Table 5. Univariate and multivariate Fama-MacBeth regressions results of expected equity excess returns on the factors over 1973-2021

Coefficient	Value	1		2		3		4		5		6	
Intercept	Mean	1.191		1.177		1.198		1.178		1.151		1.168	
	Std. Err.	0.248		0.247		0.249		0.250		0.250		0.247	
	t-statistic	4.798	***	4.761	***	4.819	***	4.704	***	4.604	***	4.726	***
LFP	Mean	0.009										0.004	
	Std. Err.	0.009										0.010	
	t-statistic	0.924										0.466	
PCE	Mean			0.020								0.017	
	Std. Err.			0.027								0.028	
	t-statistic			0.753								0.596	
INFL	Mean					0.008						0.009	
	Std. Err.					0.008						0.009	
	t-statistic					1.003						1.009	
UNRATE	Mean							-0.066				0.138	
	Std. Err.							0.122				0.199	
	t-statistic							-0.542				0.693	
LDR	Mean									-0.023		-0.023	
	Std. Err.									0.029		0.031	
	t-statistic									-0.788		-0.735	

Note. Columns (1), (2), (3), (4), and (5), show the results for univariate Fama-MacBeth regression results using only labor force participation rate (LFP), real personal consumption expenditure (PCE), core CPI inflation (INFL), unemployment rate (UNRATE), and the loan-to-deposit ratio (LDR), respectively. Column (6) shows the multivariate Fama-MacBeth regression results including all five factors as explanatory variables. Standard errors and t-statistics are calculated using the Newey-West adjustment with 6 lags.
*p<0.10, **p<0.05, ***p<0.001.

Given the potential for factor contamination, Table 6 presents the results of the Fama-MacBeth procedure using time series factor loadings estimated in univariate time-series regressions where each assets' excess return is regressed on each factor individually rather than in a multivariate time-series regression. The results are robust to the adjustment in FMP construction, as the factors' risk premiums are insignificant and have identical signs to those in Table 5. Similarly, the results in table 7, which show the univariate specifications of the Fama-MacBeth regressions using individually estimated factor loadings, are consistent with the multivariate Fama-MacBeth regression where the risk premiums are insignificant and have the same signs. However, despite the risk premiums' insignificance, it is worth noting that the size of the risk premiums which are most likely to be subjected to factor contamination, namely labor force participation rate and real personal consumption expenditure are more positive, whereas the unemployment rate's risk premium is less negative. This should be interpreted with caution due to the errors-in-variables bias present in Fama-MacBeth regressions which leads to an overestimation (positive bias) of the risk premiums.

Table 6. Univariate t-test results on factor risk premiums estimated in multivariate Fama-MacBeth cross-sectional regressions over 1973-2021 using FMPs estimated in univariate time series regressions

	Constant		**LFP**	**PCE**	**INFL**	**UNRATE**	**LDR**
Mean	1.180		0.012	0.023	0.010	0.132	-0.020
Std. Err.	0.248		0.011	0.027	0.009	0.175	0.034
t-statistic	4.766	***	1.137	0.843	1.046	0.753	-0.601

Note. In the cross-sectional regressions stocks are weighted based on their 1-month lagged market capitalization. Standard errors and t-statistics are estimated with a Newey-West adjustment with a lag of 6 months.

*p<0.10, **p<0.05, ***p<0.001.

Table 7. Univariate and multivariate Fama-MacBeth regressions results of expected equity excess returns on the factors using FMPs estimated in univariate time series regressions over 1973-2021

Coefficient	Value	1		2		3		4		5		6	
Intercept	Mean	1.183		1.174		1.197		1.178		1.155		1.180	
	Std. Err.	0.247		0.247		0.247		0.249		0.248		0.248	
	t-statistic	4.785	***	4.750	***	4.850	***	4.735	***	4.651	***	4.766	***
LFP	Mean	0.008										0.012	
	Std. Err.	0.008										0.011	
	t-statistic	0.896										1.137	
PCE	Mean			0.013								0.023	
	Std. Err.			0.027								0.027	
	t-statistic			0.491								0.843	
INFL	Mean					0.005						0.010	
	Std. Err.					0.008						0.009	
	t-statistic					0.618						1.046	
UNRATE	Mean							-0.050				0.132	
	Std. Err.							0.135				0.175	
	t-statistic							-0.373				0.753	
LDR	Mean									-0.019		-0.020	
	Std. Err.									0.030		0.034	
	t-statistic									-0.619		-0.601	

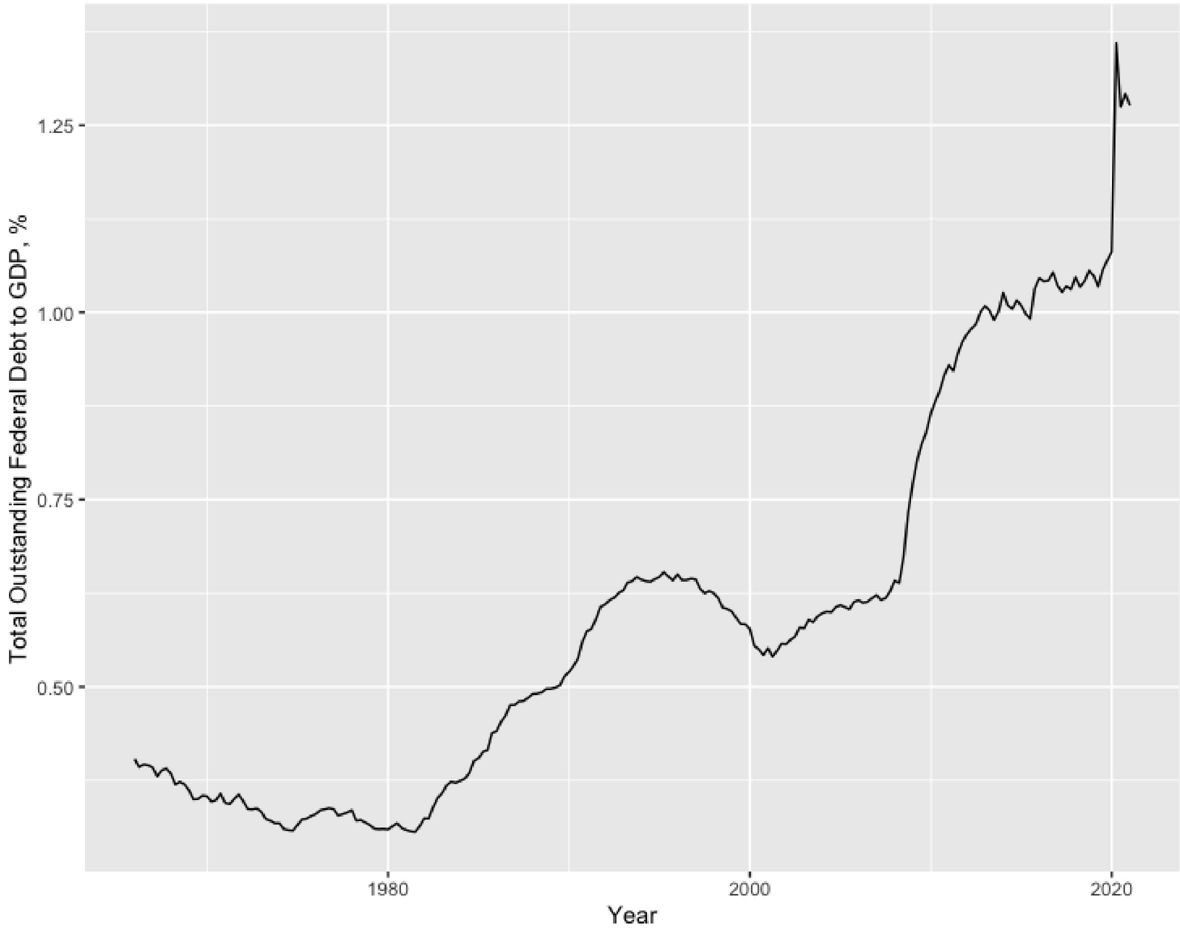
Note. Columns (1), (2), (3), (4), and (5), show the results for univariate Fama-MacBeth regression results using only labor force participation rate (LFP), real personal consumption expenditure (PCE), core CPI inflation (INFL), unemployment rate (UNRATE), and the loan-to-deposit ratio (LDR), respectively. Column (6) shows the multivariate Fama-MacBeth regression results including all five factors as explanatory variables. Standard errors and t-statistics are calculated using the Newey-West adjustment with 6 lags.

*p<0.10, **p<0.05, ***p<0.001.

The impact of the degree of government indebtedness on the loan-to-deposit ratio is clearly shown in Figure 2, where a decline in the marginal revenue product of debt due to diminishing returns to the use of debt corresponds with a decline in the velocity of money, money multiplier, and the loan-to-deposit ratio. As such, it is of interest to compare the sign of the loan-to-deposit ratio factor risk premium prior to and after the US became a highly indebted country. Figure 3 shows that the US first becomes a highly indebted country at the end of the second quarter in 1991 and becomes highly indebted for extended periods of time thereafter. Therefore, two Fama-MacBeth regressions are performed using sample date ranges of January 1973 to August 1991 and September 1991 to May 2021 and their results are shown in Table 8 and 9, respectively. Table 8 shows that the loan-to-deposit ratio factor risk premium remains insignificant with a negative sign prior to the US becoming a highly indebted country. Interestingly, the inflation factor risk premium is significant at the 1% level, commanding a risk premium of 3.25 basis points per month. Shortening the sample date range to when the US became highly indebted does not lead to a significant positive risk premium for the loan-to-deposit ratio. Possible explanations for this result are measurement error in either the numerator or denominator of the loan-to-deposit ratio, errors-in-variables bias, or the loan-to-deposit ratio just simply being a noisy proxy for the velocity of money, the money multiplier, and the money supply.

Figure 3.

The evolution of US indebtedness



Note. Quarterly time series of the ratio of total outstanding Federal debt to GDP from December 1965 to June 2021. Data are from the Federal Research of St. Louis Research website.

Table 8. Univariate t-test results on factor risk premiums estimated in multivariate Fama-MacBeth cross-sectional regressions over 1973-1991

	Constant		**LFP**	**PCE**	**INFL**		**UNRATE**	**LDR**
Mean	0.915		0.019	-0.009	0.0325		0.178	-0.028
Std. Err.	0.455		0.012	0.027	0.014		0.120	0.037
t-statistic	2.011	***	1.672	-0.313	2.252	***	1.484	-0.747

Note. In the cross-sectional regressions stocks are weighted based on their 1-month lagged market capitalization. Standard errors and t-statistics are estimated with a Newey-West adjustment with a lag of 5 months.

*p<0.10, **p<0.05, ***p<0.001.

Table 9. Univariate t-test results on factor risk premiums estimated in multivariate Fama-MacBeth cross-sectional regressions over 1991-2021

	Constant		**LFP**	**PCE**	**INFL**	**UNRATE**	**LDR**
Mean	1.355		0.004	0.024	0.014	-0.081	0.003
Std. Err.	0.290		0.011	0.037	0.011	0.245	0.033
t-statistic	4.671	***	0.333	0.664	1.255	-0.329	0.096

Note. In the cross-sectional regressions stocks are weighted based on their 1-month lagged market capitalization. Standard errors and t-statistics are estimated with a Newey-West adjustment with a lag of 5 months.

*p<0.10, **p<0.05, ***p<0.001.

6. Conclusion

The shortcomings of the CAPM in explaining in the cross-section of expected equity returns serves as the primary motivation for the consideration of macroeconomic and monetary variables that could explain the cross-section of expected equity returns. The labor force participation rate, real personal consumption expenditure, core CPI inflation, the unemployment rate, and the loan-to-deposit ratio were chosen as factors to potentially explain the cross-section of expected equity returns. Using the two-step Fama-MacBeth procedure, the factors' resulting risk premiums were insignificant and could not explain the cross-section of expected equity returns. Despite their insignificance, most of the signs of the factor risk premiums were consistent with what was anticipated. The loan-to-deposit ratio factor's risk premium contained a negative sign which was inconsistent with what was expected due to its positive association with the velocity of money, the money multiplier (and as such the money supply), and correspondingly economic output, aggregate profitability, and subsequently the cross-section of expected equity returns. To account for the deleterious effects of a falling marginal revenue product of debt on the loan-to-deposit ratio, Fama-MacBeth regressions were performed in two periods, the period before and after the US became a highly indebted country. The loan-to-deposit ratio maintained its insignificance and the sign of its risk premium remained negative in the period prior to the US becoming a highly indebted country and became positive in the period after, which is inconsistent with what was expected. In sum, the factors employed in attempting to explain the cross-section of expected equity returns were insignificant.

A noteworthy limitation of this paper is the methodology employed for FMP and risk premia estimation. The Fama-MacBeth two-step regression is subject to severe econometric issues that can taint the significance of both the FMP and its corresponding risk premia. The Fama-MacBeth approach suffers from errors-in-variables bias, which inhibits the statistical inferences one can make on the corresponding risk premiums estimated. Additionally, when factors are measured with error and are correlated to other latent factors, the FMPs, which are the time-series factor loadings estimated for each asset in a multivariate time-series regression of excess returns on the factors, become contaminated. Contaminated FMPs represent both the underlying factor of interest and the factors the underlying factor is correlated to, which results in a factor risk premium that does not solely reflect the underlying factor's risk. To account for this, FMPs for each factor were estimated in univariate time-series regressions of each stock's excess returns on factors individually as regressors. Despite this adjustment to account for plausible factor contamination, the factor risk premiums remained insignificant. Future research could use the novel method of estimating and constructing FMPs and their risk premiums for non-traded factors developed by Pukthuanthong et al. (2019), which resolves the key econometric issues that plague non-traded factor asset pricing analysis. Furthermore, additional research on monetary variables and their relation to the cross-section of expected equity returns is vital due to the exponentially increasing importance of monetary policy transmission in the form of higher asset prices.

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