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Financial Constraints, Debt Capacity, and the Cross-section of Stock Returns

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ABSTRACT

Building on a model of corporate investment under collateral constraints, we develop and test a hypothesis on the differential effect of debt capacity on stock returns across financially constrained and unconstrained firms. Consistent with the hypothesis, we find that debt capacity is a significant determinant of stock returns only in the cross-section of financially constrained firms, after controlling for beta, size, book-to-market, leverage, and momentum. The findings suggest that cross-sectional differences in corporate investment behavior arising from financial constraints, predicted by theories of imperfect capital markets and supported by empirical evidence, are reflected in the stock returns of manufacturing firms.

THE IMPACT OF ASYMMETRIC information and agency problems on corporate investment behavior has been the subject of extensive theoretical and empirical research. Myers and Majluf (1984) and Greenwald, Stiglitz, and Weiss (1984) show how external finance in the equity market can be costly when there exists an adverse selection problem of the sort analyzed by Akerlof (1970). Jaffee and Russell (1976) and Stiglitz and Weiss (1981) show that such an adverse selection problem can also lead to costly external finance in the debt market.[1] These models of imperfections in capital markets imply that uncollateralized external financing is more costly than internal financing for those firms facing high information costs or severe incentive problems.[2]

This departure from the frictionless neoclassical world of Modigliani and Miller (1958) has important macroeconomic implications as well. Bernanke

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[1] Jensen and Meckling (1976) show that agency problems may also generate a wedge between the costs of internal and external finance.

[2] Fazzari, Hubbard, and Petersen (1988) pioneered empirical research that studies the behavior of corporate investment under capital market imperfections. See Hubbard (1998) and Stein (2003) for a comprehensive survey of this literature.

and Gertler (1989), Greenwald and Stiglitz (1993), and Kiyotaki and Moore (1997), for example, study the role of financial market imperfections in the propagation and amplification of business cycle fluctuations, and they show how relatively small macroeconomic shocks can generate large, persistent fluctuations in investment and asset prices.[3] The focus of the extant empirical research in this literature has been primarily on the differences in the cyclical behavior of corporate investment across firms, arising from their differential access to capital markets.[4] But theories of financial market imperfections have strong cross-sectional implications not only for corporate investment, but also for asset prices. In fact, changes in asset prices induced by the impact of credit constraints on investment are at the heart of Kiyotaki and Moore's (1997) argument for how credit constraints can play an important role in propagating and amplifying business cycle fluctuations. When debts have to be secured by collateral, firms with higher debt capacity in the form of higher collateral value will be able to borrow more, which in turn allows more investment in assets that can serve as collateral for further borrowing. This dynamic interaction between credit limits, investments, and the values of firms' assets and liabilities is the so-called "credit multiplier" effect of the shock transmission mechanism.

This paper investigates whether stock returns reflect the credit multiplier effect. The intuition for how the credit multiplier effect may show up in the cross-section of stock returns can be summarized as follows. For financially constrained firms whose investments are below the first-best level, higher debt capacity implies a higher sensitivity of collateralized investment to changes in the availability of internal funds: A marginal increase in internal funds will support more borrowing and investment for those firms that invest in assets with higher collateral value. Thus, to the extent that the net present value of investment is reflected in stock prices, higher debt capacity firms' stock prices will be more sensitive to changes in the availability of internal funds. In other words, high debt capacity firms are more exposed to the credit multiplier effect than low debt capacity firms. In the language of asset pricing, higher debt capacity firms have higher exposure to the risk associated with changes in the availability of internal and external funds for investment. Consequently, if such risk is priced by the market, then we should expect that high debt capacity firms will earn higher returns on average than low debt capacity firms, after controlling for other risk characteristics that determine the cross-section of stock returns. On the other hand, for financially unconstrained firms whose level of investment is independent of debt capacity, the cross-sectional differences in debt capacity will have no systematic relation with the cross-section of stock returns.

We formalize this intuition by developing several testable hypotheses based on the "quantity" constraint model of corporate investment in Almeida and

[3] See Bernanke, Gertler, and Gilchrist (1996, 1999) for a comprehensive survey of this literature.

[4] Empirical evidence in this literature includes Gertler and Gilchrist (1994) and Kashyap, Lamont, and Stein (1994), who find that inventory investment is more responsive to changes in credit market conditions for those firms with more limited access to capital markets.

Campello (2007). In their model, a firm's debt capacity increases with asset tangibility as higher tangibility implies higher value of collateral for lenders. They show that investment–cash flow sensitivities are increasing in the asset tangibility of financially constrained firms while asset tangibility has no effect on investment–cash flow sensitivities of unconstrained firms, and provide empirical evidence supportive of the prediction. We show that the model provides strong cross-sectional predictions not only for the relation between investment–cash flow sensitivities and debt capacity, but also for the relation between stock returns and debt capacity of financially constrained versus unconstrained firms.

We test the hypothesis about the differential effects of debt capacity on stock returns across financially constrained and unconstrained firms in the cross-sectional regression framework. Given the lack of consensus on the best observable firm characteristic to proxy for the status of financial constraints, we use four alternative firm classification criteria for robustness: (i) asset size in terms of the book value of total assets, (ii) payout ratio, (iii) bond rating, and (iv) commercial paper rating. As an empirical measure of a firm's debt capacity, we use the firm-level tangibility measure in Almeida and Campello (2007), which is the expected asset liquidation value of a firm constructed based on the findings of Berger, Ofek, and Swary (1996). The higher the asset tangibility, the higher the firm's debt capacity since higher tangibility implies higher collateral value for lenders.

Consistent with the hypothesis, we find that debt capacity is an important determinant of the cross-section of financially constrained firms' stock returns, over and above the theoretical and empirical risk proxies such as beta, size (market capitalization), book-to-market, leverage, and momentum. The positive marginal impact of debt capacity on financially constrained firms' stock returns is both economically and statistically significant. In contrast, debt capacity has no systematic relation with the cross-section of financially unconstrained firms' stock returns. The findings are robust to the way in which firms are classified into constrained and unconstrained groups as the results hold under each of the four classification schemes.

Our findings are consistent with theories of financial market imperfections such as the financial accelerator effect of Bernanke et al. (1996) or the credit multiplier effect of Kiyotaki and Moore (1997). Empirical evidence for these effects includes Gertler and Gilchrist (1994), Kashyap et al. (1994), and more recently Almeida and Campello (2007), who find systematic differences in *corporate investment behavior* across financially constrained and unconstrained firms. This paper complements and extends their findings by providing evidence for the differential impact of debt capacity on the *behavior of stock returns* across financially constrained and unconstrained firms. This paper also contributes to recent research investigating whether financial constraints are priced in the market, such as Lamont, Polk, and Saá-Requejo (2001) and Whited and Wu (2006), by providing evidence that is arguably better grounded in economic theory. Our evidence for the credit multiplier effect on stock returns, however, is limited in scope as we focus on the cross-sectional implications, without directly investigating how the credit multiplier effect operates through the time-series dynamics of stock returns. Perez-Quiros and Timmermann (2000) and Campello and Chen (2005) are recent examples studying intertemporal implications of financial constraints. Further investigation of the link between the cross-sectional stock returns and their time-series dynamics over the business cycle would help us better understand the credit multiplier effect on stock returns. We leave this task for future research.

The paper is organized as follows. In Section I, we illustrate the logic behind our empirical tests by developing testable hypotheses based on a model of corporate investment under collateral constraints. Section II describes the data, econometric methodology, and empirical specifications for the tests. Section III presents empirical results along with the discussion of related literature, and Section IV concludes the paper.

I. Corporate Investment under Collateral Constraints

We use the model in Almeida and Campello (2007) to develop several testable hypotheses about the impact of debt capacity on stock returns of financially constrained and unconstrained firms. In contrast to previous papers such as Fazzari et al. (1988) and Kaplan and Zingales (1997), where firms face financial constraints in terms of higher *costs* of external funds, Almeida and Campello develop a model of corporate investment in which firms face a *quantity* constraint on the amount of external funds available for borrowing.[5] The model presented below is very simple and highly stylized. Its purpose is not to derive precise testable implications on stock returns in a rigorous manner, but rather to illustrate the logic and intuition behind our hypotheses and empirical tests in a simple and straightforward way.

The economy has two dates. At time 0, a firm invests I, which yields output $f(I)$ at time 1, where the production technology $f(\cdot)$ is an increasing and concave function. At time 0, the firm has internal funds W available for investment, and may also supplement W by some amount of external financing B for an optimal level of investment.

The credit constraint is modeled in the form of limited pledgeability of assets using Hart and Moore's (1994) inalienability of human capital assumption. The production technology requires not only physical investment I, but also the entrepreneur's human capital as inputs. Because of the inalienability of human capital, the entrepreneur cannot credibly commit her input to the production process. Consequently, as Hart and Moore (1994) show, the entrepreneur faces

[5] The argument for quantity constraints being more relevant than cost constraints has been advanced by many papers, including the credit rationing models of Jaffee and Russell (1976), Stiglitz and Weiss (1981), and Greenwald et al. (1984). In particular, Greenwald et al. argue that many firms face financing constraints in the form of "the availability of credit, not the price which they have to pay" (p. 194). Empirical evidence consistent with this notion of quantity constraints or credit rationing includes Kashyap, Stein, and Wilcox (1993), Kashyap et al. (1994), and Petersen and Rajan (1994, 1995).

credit constraints in this setting: She can only borrow up to the expected value of the firm in liquidation.[6]

The cost of liquidation varies across firms. More specifically, if the entrepreneur leaves the firm and the firm's assets are seized by its creditors at time 1, only a fraction $\tau \in (0, 1)$ of the proceeds I can be recovered. The fraction τ is firm-specific, and can be viewed as a function of the tangibility of the firm's physical assets that affects the amount of credit for the firm. As only the tangible, physical assets can serve as collateral, ceteris paribus, the assets of high τ firms are worth more to creditors than those of low τ firms, and hence they are able to borrow more than the firms with low τ. In this sense, τ can be thought of as a measure of the firm's debt capacity, and interpreted more broadly as a (decreasing) function of the degree of credit constraints faced by the firm.

Given the firm's internal funds W, the entrepreneur chooses investment I and borrowing B to maximize the value of equity. Assuming for simplicity that the discount rate is equal to zero and the price of the physical goods invested by the firm is equal to one at both time 0 and time 1, the net present value of the firm's investment is $f(I) - I$. The value of the firm's assets in liquidation, τI, imposes the borrowing constraint for the firm: $B \leq \tau I$.[7]

The entrepreneur's optimization problem can be formally written as

$$\max_{I} f(I) - I, \tag{1}$$

$$\text{s.t.} \quad I \leq W + \tau I. \tag{2}$$

The first-best level of investment I^{FB} is given by

$$f'(I^{FB}) = 1. \tag{3}$$

The firm will invest at the first-best level if internal funds and borrowing capacity are sufficiently high so that the credit constraint is not binding. Formally, I^{FB} is feasible if

$$W + \tau I^{FB} \geq I^{FB}. \tag{4}$$

Investment will be constrained when the credit constraint is binding

$$W < W^{*}(\tau) = (1 - \tau) I^{FB}. \tag{5}$$

[6] Almeida and Campello (2007) show that the model's main implications do not hinge on the assumption of inalienable human capital: The model's main predictions do not change when Holmstrøm and Tirole's (1997) moral hazard setup is used instead of Hart and Moore's (1994) inalienability of human capital assumption.

[7] For the implicit assumptions and implications of this particular form of borrowing constraint, see footnotes 7 and 8 in Kiyotaki and Moore (1997).

Therefore, the optimal level of investment is

$$
\begin{aligned}
I(W, \tau) &= \frac{W}{1-\tau}, \quad \text{if } W < W^*(\tau) \\
&= I^{FB}, \qquad \text{otherwise.}
\end{aligned} \tag{6}
$$

From this result, Almeida and Campello (2007) derive the following implication on the relation between the investment–cash flow sensitivity and the tangibility of assets:

$$
\begin{aligned}
\frac{\partial I(W, \tau)}{\partial W} &= \frac{1}{1-\tau}, \quad \text{if } W < W^*(\tau) \\
&= 0, \qquad \text{otherwise.}
\end{aligned} \tag{7}
$$

The model predicts that the investment–cash flow sensitivity increases with asset tangibility when the firm is financially constrained, but asset tangibility has no impact on the investment–cash flow sensitivity for financially unconstrained firms. In the model, financially constrained firms refer to those firms unable to undertake the first-best level of investment due to the lack of internal funds and/or sufficiently low debt capacity. Similarly, financially unconstrained firms refer to those firms with enough internal funds and/or sufficiently high debt capacity for making the first-best level of investment.[8]

We develop further hypotheses from this model about the cross-sectional relation between debt capacity and stock returns. Let the net present value of investment for a financially constrained firm be $V^C \equiv f(I^C) - I^C$. Similarly, let the net present value of investment for a financially unconstrained firm be $V^U \equiv f(I^U) - I^U$. Since this firm will invest at the first-best level, $I^U = I^{FB}$. Consider the marginal effect of changes in internal funds on V^C and V^U:

$$
\frac{\partial V^C}{\partial W^C} = \frac{\partial V^C}{\partial I^C}\frac{\partial I^C}{\partial W^C} = \frac{f'(I^C) - 1}{(1-\tau^C)}, \tag{8}
$$

$$
\frac{\partial V^U}{\partial W^U} = \frac{\partial V^U}{\partial I^U}\frac{\partial I^U}{\partial W^U} = 0. \tag{9}
$$

Since $I^C < I^{FB}$ and $f'(I^{FB}) = 1$, the marginal product of investment for the constrained firm, $f'(I^C)$, is greater than one, which implies $\frac{\partial V^C}{\partial W^C} > 0$. For financially constrained firms, the net present value of investment is sensitive to changes in internal funds, whereas for financially unconstrained firms, the net present value of investment is independent of changes in internal funds. Furthermore, it can be shown that the sensitivity of the net present value of investment to changes in internal funds increases with the measure of debt capacity, τ^C,

[8] Almeida and Campello (2007) show that the model's main implications do not change when firms face financing constraints in terms of higher costs rather than a restricted amount of borrowing.

for sufficiently constrained firms whose investments are not too close to the first-best level. Formally,

$$\frac{\partial^2 V^C}{\partial W^C \partial \tau^C} = \frac{\Psi(I^C)}{(1-\tau^C)^2}, \tag{10}$$

where $\Psi(I^C) \equiv [f'(I^C) - 1 + f''(I^C)I^C]$. The sign of $\Psi(I^C)$ depends on the severity of credit constraints faced by the firm. More specifically,

$$\Psi(I^C) > 0, \quad \text{if } I^C < \frac{f'(I^C) - 1}{|f''(I^C|}, \tag{11}$$

$$\Psi(I^C) \leq 0, \quad \text{if } I^C \geq \frac{f'(I^C) - 1}{|f''(I^C)|}. \tag{12}$$

As long as debt capacity or the level of internal funds is sufficiently low so that the level of constrained investment is not too close to the first-best level (i.e., condition (11) is satisfied), the sensitivity of the net present value of investment to changes in internal funds increases with the measure of debt capacity τ^C. The condition for being sufficiently constrained, equation (11), can be restated as $f'(I^C) - 1 + f''(I^C)I^C > 0$, which provides the following economic interpretation: Firms are sufficiently constrained when the net marginal product of investment is greater than the average loss arising from decreasing marginal productivity.

For financially constrained firms whose investments are below the first-best level, higher debt capacity implies a higher sensitivity of collateralized investment to changes in the availability of internal funds: A marginal increase in internal funds will support more borrowing and investment for those firms that invest in assets with higher collateral value. Thus, to the extent that the net present value of investment is reflected in stock prices, higher debt capacity firms' stock prices will be more sensitive to changes in the availability of internal funds.

To the extent that stock prices reflect the net present value of investment, the results above have the following implications. Among those firms that are sufficiently constrained, higher debt capacity implies a higher sensitivity of collateralized investment to changes in the availability of internal funds, since a marginal increase in internal funds will support more borrowing and investment for those firms that invest in assets with higher collateral value. For these sufficiently constrained firms, therefore, higher debt capacity implies higher exposure to the effect of variation in internal funds on the net present value of investment. In other words, only the financially constrained firms are exposed to the credit multiplier effect on investment, and the exposure increases with debt capacity among those firms that are sufficiently constrained. Consequently, if this risk is priced by the market, then we should expect a positive association between expected returns and debt capacity in the cross-section of firms that are sufficiently constrained, after controlling for other systematic risk characteristics. On the other hand, debt capacity will have no systematic relation with expected returns in the cross-section of financially unconstrained firms whose exposure to the risk of variation in internal funds is negligible, as they have easier and wider access to alternative sources of capital.

II. Data and Empirical Specification

A. Data

The sample consists of manufacturing firms (SIC codes between 2000 and 3999) over the 1973 to 2001 period with valid information on total assets, market capitalization, capital expenditures, cash and short-term investments, inventories, and capital stock (property, plant, and equipment) from COMPUSTAT annual data in a given year t. An additional sample requirement is that the firms must have at least 24 monthly CRSP return observations from the 60-month period ending in June of year $t+1$ for estimation of risk-adjusted returns using the three-factor model of Fama and French (1993).[9]

B. Econometric Methodology and Empirical Specification

A simple econometric framework well-suited for testing our hypothesis is the cross-sectional regression approach of Fama and MacBeth (1973). This approach, however, suffers from the well-known errors-in-variable bias arising from errors in estimating factor loadings (β), which can be severe particularly for individual stock returns. We therefore follow the approach taken by Brennan, Chordia, and Subrahmanyam (1998), who propose using risk-adjusted returns as the dependent variable instead of using the estimated factor loadings as the independent variables to avoid the errors-in-variable problem.[10] Using the three-factor model of Fama and French (1993) as the benchmark model for risk-adjustment, we define the risk-adjusted return for individual stocks as follows:

$$R^*_{jt} = R_{jt} - R_{ft} - \sum_{k=1}^{3} \hat{\beta}_{jk} F_{kt}, \tag{13}$$

where R_{jt} is the return on stock j at t, R_{ft} is the risk-free rate (T-bill rate) at t, and F_{kt} denotes one of the three Fama–French factors (market, size, and book-to-market). We estimate the factor loadings ($\hat{\beta}_{jk}$) for individual stocks using monthly rolling regressions with a 60-month window every month requiring at least 24 monthly return observations in a given window. We also use the Dimson (1979) procedure with one lag to allow for thin trading in the estimation of factor loadings.[11]

Using the cross-section of risk-adjusted returns as the dependent variable, we run Fama–MacBeth regressions separately for the sample of financially

[9] We thank Kenneth French for making the data available on his Web site: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[10] We thank Rob Stambaugh for suggesting this approach.

[11] See Brennan et al. (1998) for more details on the estimation procedure and underlying assumptions on the expected returns within the APT framework.

constrained and unconstrained firms, using four alternative criteria to classify firms into the financially constrained and unconstrained groups. The regression model for the cross-section of N stocks for time period t is

$$R^* = \gamma_0 \iota + \gamma_1 Z + \gamma_2 \xi + \eta, \tag{14}$$

where R^* is the $(N \times 1)$ vector of risk-adjusted excess returns, ι is the $(N \times 1)$ vector of ones, Z is the $(N \times K)$ matrix of lagged firm characteristics known to be systematically related to the cross-section of stock returns, and ξ is the $(N \times 1)$ vector of lagged empirical proxies for debt capacity. The hypotheses to be tested are that $\gamma_2 > 0$ for the sample of financially constrained firms, and $\gamma_2 = 0$ for the sample of unconstrained firms.[12]

Although we control for risk by using risk-adjusted returns as the dependent variable, the risk-adjustment procedure may not completely account for many firm characteristics found to have significant explanatory power for the cross-sectional returns beyond beta. Controlling for these firm characteristics is important for testing our hypothesis since our empirical proxies for debt capacity may well be correlated with some of these firm characteristics possibly unrelated to credit constraints. Thus, for robustness, we select the three most prominent firm characteristics found to be systematically related to the cross-section of stock returns in the empirical asset pricing literature (size, book-to-market, and return momentum) as lagged firm characteristics to be included in the regression.[13]

Following Fama and French (1992), size is defined as the logarithm of the market value of equity in June of year t, and the book-to-market ratio is defined as the logarithm of the ratio of the book value of equity to the market value of equity in December of year $t-1$, for the firms classified based on COMPUSTAT annual data in year $t-1$. The proxies for debt capacity, which will be described below, are measured using COMPUSTAT annual data in year $t-1$. In the Fama–MacBeth regressions, these annual values of independent variables for individual firms are matched with the risk-adjusted returns for the months from July of year t to June of year $t+1$. Return momentum is measured as the sum of the returns for the rolling 6-month window ending 2 months prior to the month of the dependent variable return.

As an empirical proxy for debt capacity, we use the firm-level tangibility measure in Almeida and Campello (2007), which is the expected asset liquidation value of a firm constructed based on the findings of Berger et al. (1996). Using the sample of firms with discontinued operations over the 1984 to 1993 period, obtained from the National Automated Accounting Research Service (NAARS) library of Lexis/Nexis, Berger et al. find that a dollar's book value produces

[12] Using simple excess returns without risk adjustment as the dependent variable does not change our main findings.

[13] Fama and French (1992) find that in the presence of size and book-to-market, other firm characteristics found to be associated with stock returns (such as leverage and the earnings-to-price ratio) do not have marginal explanatory power. Fama and French (1996), however, find that the mometum effect remains even in the presence of size and book-to-market.

72 cents for receivables, 55 cents for inventory, and 54 cents for fixed assets on average when firms sell these major asset classes. Accordingly, the measure of asset tangibility is constructed for each firm-year as follows:

$$\text{Tangibility} = \frac{\text{cash holdings} + 0.715 \times \text{receivables} + 0.547 \times \text{inventory} + 0.535 \times \text{PPE}}{\text{total assets}}. \tag{15}$$

The COMPUSTAT data item numbers for the components of *Tangibility* are as follows: cash holdings (item 1), receivables (item 2), inventory (item 3), PPE (property, plant, and equipment, item 8), and total assets (item 6).

C. Financial Constraints Criteria for Firm Classification

Testing our hypothesis requires classifying firms into financially constrained and unconstrained groups. While there are a number of a priori measures of the degree of financial constraints used for firm classification in the literature, it is debatable to some extent whether these measures correctly capture the degree of financing frictions faced by firms. Accordingly, we use a number of alternative classification criteria that have been widely used in the literature, following Gilchrist and Himmelberg (1995) and Almeida and Campello (2007). As the hypothesis to be tested focuses on the differential marginal effects of debt capacity on stock returns across constrained and unconstrained firms, whether different sample splits lead to consistent results is important for robustness of the findings.[14]

Classification Scheme 1 (Asset Size): Gertler and Gilchrist (1994), among others, use asset size in terms of the book value of total assets as a measure of financial constraints or capital market access, arguing that small firms are more likely to face financing constraints because they are typically younger and less well known, and thus more vulnerable to capital market imperfections arising from information asymmetries and collateral constraints. In each year during the sample period, we rank firms based on their asset size in terms of the book value of total assets and classify the bottom (top) three deciles of the sample firms as financially constrained (unconstrained).

Classification Scheme 2 (Payout Ratio): Dividend payout ratio was introduced by Fazzari et al. (1988) and subsequently employed in many studies in which

[14] Another potential firm classification scheme is using the KZ index, which is a linear combination of five accounting ratios constructed by Lamont et al. (2001) based on the results in Kaplan and Zingales (1997). The index is designed to measure the likelihood that a firm faces financial constraints. Almeida, Campello, and Weisbach (2004), however, find that the KZ index generates constrained/unconstrained firm classifications that are mostly negatively correlated with the four classification schemes that we use. They also find that the results for their estimates of the cash flow sensitivity of cash for the KZ index scheme are opposite to the results for the other four classification schemes, which suggests that the KZ index is a flawed measure of financial constraints. Whited and Wu (2006) also argue that the KZ index does not correctly capture the degree of financial constraints.

firms with low payout ratios are categorized as financially constrained. The rationale is that since dividends and investment are competing uses of funds, firms facing severe financing constraints would choose lower payout ratios. In each year during the sample period, we rank firms based on payout ratio measured as the ratio of total distributions (dividends plus stock repurchases) to net income, and classify the bottom (top) three deciles of the sample firms as financially constrained (unconstrained).[15]

Classification Scheme 3 (Bond Rating): Whited (1992) and Kashyap et al. (1994), among others, use the presence of bond ratings as a proxy for access to public debt markets and financial constraints. In each year during the sample period, we classify those firms with positive debt but without a Standard & Poor's (S&P) bond rating in a given year as financially constrained. Financially unconstrained firms are those with positive debt and a S&P bond rating in a given year.

Classification Scheme 4 (Commercial Paper Rating): Calomiris, Himmelberg, and Wachtel (1995), among others, use the presence of commercial paper ratings as a proxy for access to public debt markets and financial constraints. In each year during the sample period, we classify those firms with positive debt but without S&P commercial paper ratings in a given year as financially constrained. Financially unconstrained firms are those with positive debt and S&P commercial paper ratings in a given year.

While the sample period for the first two classification schemes (asset size and payout ratio) begins in 1973, the sample period for the classification schemes based on bond or commercial paper ratings begins in 1985 because COMPUSTAT does not have comprehensive coverage of bond ratings prior to 1985.

III. Empirical Results

A. *Descriptive Analysis of Financially Constrained and Unconstrained Firms*

Table I presents the number of firm-years for the constrained and unconstrained groups under each of the four firm classification schemes, displayed in the diagonal cells of the table. Based on the asset size criterion, for example, there are 10,926 financially constrained firm-years and 10,931 unconstrained firm-years. Under the payout scheme, there are 21,966 financially constrained firm-years and 6,202 unconstrained firm years. The number of firm-years in the off-diagonal cells are meant to show how the various classification schemes are related to one another. For example, of the 10,926 firm-years categorized as financially constrained according to asset size, 8,955 firm-years are also considered constrained based on payout ratio, while 916 firm-years are considered unconstrained. The remaining firm-years are considered neither constrained nor unconstrained according to the payout scheme, as they fall in the middle

[15] We exclude firms with zero payouts or negative net income when firms are ranked based on payout ratio. The constrained sample based on payout ratio is then the firms in the bottom three deciles of payout ranking plus the firms with zero payouts or negative net income. Thus, the constrained subsample will account for more than 30% of the sample firms in a given year.

Table I

Cross-classification of Financial Constraint Types

This table displays firm-year cross-classification for the various criteria used to categorize firms as financially constrained (C) or unconstrained (U) in a given year. The sample includes only manufacturing firms (SIC codes between 2000 and 3999) over the 1973 to 2001 period for the asset size and payout ratio criteria and the 1985 to 2001 period for the bond and commercial paper ratings criteria with valid information on total assets, market capitalization, capital expenditures, cash holdings, inventories, and capital stock (plant, property, and equipment) from COMPUSTAT annual data in a given year t. In addition, the sample firms must also have at least 24 monthly CRSP return observations from the 60-month period ending in June of year $t + 1$. The asset size criterion classifies firms in the bottom (top) three deciles as financially constrained (unconstrained) based on the book value of total assets. The payout ratio criterion classifies firms in the bottom (top) three deciles as financially constrained (unconstrained) based on payout ratio, defined as the ratio of total distributions (dividends plus stock repurchases) to net income (firms with zero payouts or negative net income, excluded when firms are ranked according to payout ratio, are added to the constrained group). The bond ratings (CP ratings) criterion classifies firms with positive debt but without bond (commercial paper) ratings in a given year as financially constrained, and firms with positive debt and bond (commercial paper) ratings in a given year as financially unconstrained.

Financial Constraints Criteria		Asset Size		Payout Ratio		Bond Ratings		CP Ratings	
		C	U	C	U	C	U	C	U
Asset Size	C	10,926							
	U		10,931						
Payout Ratio	C	8,955	3,881	21,966					
	U	916	2,925		6,202				
Bond Rating	C	5,359	2,629	11,312	1,733	15,624			
	U	3	3,984	1,746	1,191		4,361		
Commercial Paper Rating	C	5,362	4,274	12,626	2,008	15,426	2,218	17,644	
	U	0	2,339	432	916	198	2,143		2,341

four deciles of the payout ranking. In terms of access to the public debt market, the table reveals that most of the firms in the constrained group under the asset size or payout ratio classification schemes do not have a bond rating or a commercial paper rating. Overall, the table reveals a generally positive association among the classification criteria used, but the positive association is not so high as to make the use of multiple sample split schemes redundant.

Table II reports summary statistics on various firm characteristics separately for the sample of constrained and unconstrained firms under each of the four classification criteria. The firm characteristics reported are: asset tangibility; asset size in terms of the book value of total assets; payout ratio; book (market) leverage, measured as the ratio of the book value of debt to the book (market) value of equity; interest coverage; investment, defined as the ratio of capital expenditures to beginning-of-period capital stock (lagged property, plant, and equipment); Q (Tobin's Q), defined as the market value of assets divided by the book value of assets, where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes; market value of equity (ME) and book-to-market ratio ($BEME$) at the end of December of a

Table II

Firm Characteristics across Financial Constraint Types

This table displays summary statistics of firm characteristics across the groups of firms categorized as financially constrained (C) or unconstrained (U) in a given year by various financial constraint criteria, described in Table I's caption. The summary statistics reported are time-series averages of the cross-sectional median, mean, and standard deviations over the 1973 to 2001 period for the asset size and payout ratio criteria and the 1985 to 2001 period for the bond and commercial paper ratings criteria. The Appendix provides definitions of the firm characteristics.

Firm Characteristics		Financial Constraints Criteria							
		Asset Size		Payout Ratio		Bond Ratings		CP Ratings	
		C	U	C	U	C	U	C	U
Tangibility (Liquidation Value)	Median	0.58	0.52	0.56	0.54	0.55	0.48	0.55	0.47
	Mean	0.58	0.52	0.56	0.53	0.56	0.48	0.55	0.46
	StDev	0.10	0.09	0.10	0.09	0.11	0.10	0.11	0.09
Asset Size	Median	15	869	55	361	70	1,825	92	3,421
	Mean	16	2,733	385	2,171	211	5,086	528	7,061
	StDev	9	7,877	2,057	6,553	508	13,684	4,253	12,196
Payout Ratio	Median	0.00	0.36	0.00	0.99	0.00	0.39	0.00	0.60
	Mean	0.28	0.80	0.04	2.85	0.58	1.00	0.59	1.30
	StDev	2.25	4.37	0.07	10.41	5.39	5.00	5.47	4.91
Book Leverage	Median	0.34	0.47	0.45	0.42	0.33	0.62	0.39	0.53
	Mean	0.99	0.67	1.17	0.58	0.83	1.04	0.90	0.75
	StDev	5.74	1.08	8.95	0.98	5.32	2.01	5.28	1.28
Market Leverage	Median	0.31	0.35	0.44	0.34	0.23	0.35	0.26	0.24
	Mean	0.70	0.74	0.98	0.55	0.60	0.81	0.69	0.36
	StDev	1.16	1.62	1.82	0.77	1.41	1.63	1.59	0.43
Interest Coverage	Median	7	8	6	8	8	6	7	8
	Mean	28	21	29	26	41	12	37	13
	StDev	106	98	208	107	269	32	254	18
Investment	Median	0.20	0.21	0.22	0.19	0.21	0.20	0.21	0.20
	Mean	0.38	0.25	0.35	0.23	0.34	0.23	0.33	0.22
	StDev	1.13	0.19	0.84	0.18	1.04	0.18	0.98	0.12
Q	Median	1.15	1.20	1.12	1.15	1.25	1.34	1.23	1.57
	Mean	1.74	1.49	1.53	1.39	1.74	1.66	1.70	1.90
	StDev	1.96	0.86	1.46	0.79	1.81	0.98	1.73	1.03
ME	Median	11	832	41	303	60	1,691	77	3,664
	Mean	20	2,985	339	2,640	274	5,899	469	9,912
	StDev	27	7,195	1,469	7,422	935	12,911	2,097	16,608
BEME	Median	0.94	0.82	0.97	0.93	0.70	0.58	0.71	0.47
	Mean	1.20	1.05	1.27	1.08	0.92	0.77	0.93	0.54
	StDev	1.51	1.15	1.59	0.82	1.04	0.80	1.06	0.33
Debt-to-Asset Ratio	Median	0.20	0.24	0.24	0.22	0.19	0.28	0.21	0.25
	Mean	0.23	0.24	0.26	0.22	0.22	0.30	0.23	0.25
	StDev	0.17	0.13	0.17	0.13	0.17	0.14	0.17	0.11
Profitability (EBITDA/Assets)	Median	0.10	0.16	0.12	0.15	0.13	0.15	0.12	0.17
	Mean	0.04	0.16	0.09	0.16	0.08	0.15	0.08	0.18
	StDev	0.23	0.07	0.18	0.08	0.21	0.09	0.20	0.07

given firm classification year; debt-to-asset ratio, measured as the ratio of the book value of total debt (short-term and long-term) to the book value of total assets; and profitability, defined as the ratio of earnings before interest, taxes, depreciation, and amortization (*EBITDA*) to the book value of total assets. The cross-sectional median, mean, and standard deviation of these characteristics for the constrained and unconstrained firms are computed for each year and averaged over the sample period.

A clear pattern across the constrained and unconstrained groups emerges in asset size, payout ratio, market value of equity, and profitability: Firms in the constrained group are smaller in asset size and market value of equity, and have a lower payout ratio and profitability on average. The remaining firm characteristics show no strong patterns across the constrained and unconstrained groups that are common to the alternative classification schemes. In terms of the average cross-sectional standard deviation of these firm characteristics, an interesting pattern emerges in investment, Q, and profitability. Relative to the mean levels of investment, Q, and profitability, the average cross-sectional standard deviation is much larger for the constrained sample than for the unconstrained sample. For example, under the commercial paper rating scheme, the mean and the cross-sectional standard deviation of the investment measure are 0.33 and 0.98 for the constrained sample, while they are 0.22 and 0.12 for the unconstrained sample. A similar pattern also emerges along Q and profitability.

Table III reports summary statistics on investment, Q, leverage, asset size, market capitalization, book-to-market, and annual excess return separately for firms in the top three and the bottom three deciles of the tangibility ranking within the constrained sample firms under each of the four classification schemes. The table reveals a strong pattern in these firm characteristics across the tangibility measure that are common to the four classification schemes: Regardless of the classification scheme, high tangibility firms have higher

Table III

Firm Characteristics across Tangibility Measure within Constrained Sample

This table displays average values of various firm characteristics across the groups of low- and high-tangibility firms within the subsample of constrained firms for each financial constraints criterion. The financial constraints criteria are described in Table I's caption. The summary statistics reported are time-series averages of the cross-sectional mean values over the 1973 to 2001 period for the asset size and payout ratio criteria and the 1985 to 2001 period for the bond and commercial paper ratings criteria. The Appendix provides definitions of the firm characteristics.

	Financial Constraints Criteria							
	Asset Size		Payout Ratio		Bond Ratings		CP Ratings	
Tangibility	Low	High	Low	High	Low	High	Low	High
Investment	0.40	0.47	0.30	0.46	0.29	0.42	0.28	0.41
Q	1.56	2.86	1.36	2.39	1.50	2.37	1.44	2.30
Book Leverage	1.68	0.22	1.81	0.36	1.13	0.36	1.28	0.41
Market Leverage	0.96	0.21	1.32	0.36	0.79	0.23	0.97	0.26
Asset Size	17	15	701	139	307	137	914	230
ME	16	35	595	271	358	273	597	447
BEME	1.27	1.00	1.39	1.00	0.97	0.73	0.99	0.75
Annual Excess Return	16.02	20.07	12.91	18.17	7.87	15.27	7.58	14.98

investment, higher Q, a lower book-to-market ratio, and a higher excess return on average.

B. Fama–MacBeth Regression Results

Table IV reports the results from the Fama–MacBeth regressions in which tangibility is proxied by expected liquidation value. The Fama–MacBeth

Table IV
Fama–MacBeth Regressions: Liquidation Value as a Proxy for Tangibility

This table reports regression coefficients with the associated t-statistics (in parentheses) from the Fama–MacBeth (1973) regressions for the sample periods July 1974 to June 2003 (Panels A and B) and July 1986 to June 2003 (Panels C and D). The financial constraints criteria are described in Table I's notes. The dependent variable is the cross-section of monthly returns adjusted for risk using the Fama–French factors. The independent variables are a constant and the cross-section of ln(Size), ln(BEME), Momentum, and Tangibility. The Appendix provides definitions of the variables used in the regressions.

	Constant	ln(Size)	ln(BEME)	Momentum	Tangibility
Panel A: Asset Size as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value					
Constrained	−0.81				2.18
	(1.91)				(3.37)
	1.39	−0.31	0.16	0.00	
	(3.70)	(2.88)	(1.42)	(1.26)	
	−0.32	−0.37	0.18	0.00	3.10
	(0.65)	(3.39)	(1.56)	(1.25)	(5.04)
Unconstrained	−0.01				0.23
	(0.03)				(0.43)
	0.17	−0.04	−0.13	0.00	
	(0.65)	(1.08)	(1.65)	(0.69)	
	0.20	−0.04	−0.14	0.00	−0.05
	(0.50)	(0.99)	(1.69)	(0.76)	(0.09)
Panel B: Payout Ratio as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value					
Constrained	−0.80				1.82
	(2.59)				(3.34)
	0.72	−0.14	0.06	0.00	
	(2.34)	(2.54)	(0.66)	(0.08)	
	−0.34	−0.12	0.12	0.00	1.78
	(0.81)	(2.23)	(1.45)	(0.01)	(3.75)
Unconstrained	−0.33				0.88
	(0.30)				(0.57)
	0.58	−0.09	0.07	0.00	
	(2.61)	(2.39)	(0.80)	(0.38)	
	0.36	−0.08	0.07	0.00	0.34
	(0.85)	(2.18)	(0.78)	(0.23)	(0.61)

(*continued*)

Table IV—*Continued*

	Constant	ln(Size)	ln(BEME)	Momentum	Tangibility
Panel C: Bond Rating as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value					
Constrained	−0.57				1.68
	(1.44)				(2.21)
	1.04	−0.18	0.13	0.00	
	(2.22)	(2.05)	(1.03)	(0.72)	
	0.11	−0.16	0.17	0.00	1.60
	(0.19)	(1.87)	(1.47)	(0.69)	(2.51)
Unconstrained	−0.22				0.59
	(0.55)				(0.71)
	−0.24	0.02	−0.17	−0.01	
	(0.58)	(0.32)	(1.25)	(1.03)	
	−0.53	0.02	−0.16	−0.01	0.52
	(0.86)	(0.42)	(1.17)	(1.14)	(0.64)
Panel D: CP Rating as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value					
Constrained	−0.64				1.74
	(1.70)				(2.36)
	0.95	−0.16	0.07	0.00	
	(2.14)	(2.12)	(0.59)	(0.59)	
	0.08	−0.15	0.11	0.00	1.47
	(0.15)	(1.91)	(1.04)	(0.53)	(2.42)
Unconstrained	0.14				−0.01
	(0.39)				(0.02)
	0.11	−0.01	−0.06	−0.01	
	(0.21)	(0.16)	(0.43)	(1.95)	
	−0.02	0.00	−0.06	−0.01	0.09
	(0.03)	(0.02)	(0.40)	(2.09)	(0.13)

cross-sectional regressions are run separately for the sample of constrained and unconstrained firms over the sample periods July 1974 to June 2003 (Panels A and B) and July 1986 to June 2003 (Panels C and D). The table reports coefficient estimates and t-statistics (in parentheses).

Recall that the dependent variable is the cross-section of risk-adjusted stock returns, in which the benchmark model for risk adjustment is the Fama–French three-factor model. Therefore, under the assumption that the benchmark model is correct, any firm characteristic entered as an explanatory variable in the regression should be insignificant, regardless of financial constraint status. Our main hypothesis is that the credit multiplier effect is priced in stock returns only for those firms that are financially constrained, which translates into the prediction that the coefficient on the tangibility measure should be positive for the constrained sample but zero for the unconstrained sample.

In Panels A, B, C, and D of Table IV, firms are classified into constrained and unconstrained groups based on asset size, payout ratio, bond rating, and commercial paper rating, respectively. The results for the regression specification in which *Tangibility* is the only explanatory variable are reported in the first row for the sample of constrained and unconstrained firms in each panel. Consistent with the hypothesis, the coefficient on the tangibility measure is positive and strongly significant for the sample of constrained firms, while it is relatively small in magnitude and statistically insignificant for the sample of unconstrained firms, regardless of the firm classification scheme.

The second row for the sample of constrained and unconstrained firms in each panel reports the results for the regression specification in which the explanatory variables are ln(*Size*), ln(*BEME*), and *Momentum*, excluding *Tangibility*. The coefficient on *Momentum* is statistically insignificant everywhere except for the sample of unconstrained firms in Panel D. The coefficient on ln(*BEME*) is also insignificant, suggesting that the risk-adjustment procedure accounts for the book-to-market effect (loadings on the Fama–French book-to-market factor) well. The coefficient on ln(*Size*), however, is significant for the sample of constrained firms in each of the four classification schemes, while it is insignificant in three out of the four cases for the sample of unconstrained firms. This result suggests that the risk-adjustment procedure does not fully account for the size effect. More importantly, this raises the concern that the significance of the coefficient estimates on *Tangibility* may in fact be the result of an improperly controlled size effect that is somehow stronger for the sample of financially constrained firms.

We address this concern with the regression specification in which the explanatory variables are ln(*Size*), ln(*BEME*), and *Momentum*, in addition to *Tangibility*; the results are reported in the third row for the sample of constrained and unconstrained firms in each panel. Even in the presence of these control variables, the coefficient estimates for *Tangibility* are positive and statistically significant for the constrained sample, but insignificant for the unconstrained sample, regardless of how the firms are classified into the constrained and unconstrained groups. For the sample of constrained firms, the coefficient on *Tangibility* ranges from 3.10 (t-statistic of 5.04) in Panel A (asset size scheme) to 1.47 (t-statistic of 2.42) in Panel D (CP rating scheme). Furthermore, comparing this specification to the specification in the first row, in which ln(*Size*), ln(*BEME*), and *Momentum* are excluded from the regression, shows that the presence of these control variables (in particular ln(*Size*)) does not have much impact on either the statistical significance or the magnitude of the coefficient on *Tangibility*.

The marginal effect of tangibility on stock returns is also economically significant. As Table II reports, the cross-sectional standard deviation (averaged over the sample period) of the tangibility measure for those firms categorized as financially constrained is either 0.10 or 0.11 depending on the financial constraints criteria. Thus, the results suggest that after controlling for size, book-to-market, and momentum, the marginal effect of a one-standard deviation difference in the tangibility measure on the risk-adjusted stock returns ranges from 0.16% per month on average (CP rating scheme) to 0.31% per month on average (asset size scheme), which is a sizable magnitude.

The Fama–MacBeth regression results in Table IV suggest that debt capacity measured by tangibility is an important determinant of the cross-section of financially constrained firms' stock returns, and that the impact of debt capacity is not fully captured by beta or other widely used empirical risk proxies such as size, book-to-market, and momentum. The pattern of coefficient estimates on the measure of debt capacity reveals its differential marginal effect on stock returns across financially constrained and unconstrained firms precisely in the way we hypothesized. Furthermore, the results are robust to the way in which firms are categorized as financially constrained and unconstrained, as the results hold under each of the four alternative classification schemes.

C. Robustness Checks

As a robustness check for the regression specification, we consider controlling for leverage in addition to size, book-to-market, and momentum. Debt capacity as measured by tangibility is likely to be associated with the level of debt held by a firm, and the effect of tangibility on the cross-sectional returns may be due to the usual leverage effect unrelated to financial constraints. Table V reports the Fama–MacBeth regression results in which tangibility is proxied by liquidation value and either book leverage or market leverage is added to the baseline specification. *Book (market) leverage* is defined as the ratio of the book value of short- and long-term debt to the book (market) value of equity. In Panels A, B, C, and D, firms are classified into constrained and unconstrained groups based on asset size, payout ratio, bond rating, and commercial paper rating, respectively. The results show that the effect of tangibility on the cross-sectional returns is not due to leverage. Even with the leverage control, the coefficient on *Tangibility* is strongly significant for the constrained sample but insignificant for the unconstrained sample, under each of the four classification schemes.

Are the results robust to using an alternative measure of asset tangibility? Constructing a firm-level measure that captures the notion of the value of pledgeable assets in debt financing is not an easy task. The most widely used proxy for asset tangibility in the finance literature appears to be the fixed asset ratio, defined as the ratio of PPE to total assets. Papers in the capital structure literature, such as Titman and Wessels (1988), Shyam-Sunder and Myers (1999), Frank and Goyal (2003), and Korajczyk and Levy (2003), use a version of this fixed asset ratio as a proxy for asset tangibility. In our view, however, this fixed asset ratio would not be a useful alternative proxy for a robustness check, since the baseline asset tangibility measure that we use can be viewed as an augmented version of the fixed asset ratio. Given the lack of a plausible alternative proxy for the value of pledgeable assets at the firm level, we examine the baseline tangibility measure by modifying the measure to capture the notion of unused debt capacity.

One of the rationales for using asset tangibility as a measure of debt capacity is the following: Ceteris paribus, the greater the size of collateralizable assets, the greater would be the amount of borrowing available for investment when the firm is financially constrained. The tangibility measure, however, does not take into account the extent to which the firm's tangible assets are already put up as collateral for existing debt. In order to account for the cross-sectional variation in the level of existing debt, we modify the tangibility measure to capture the notion of unused debt capacity by subtracting the book value of total debt from the expected liquidation value of the firm as follows:

$$\text{Tangibility} = \frac{\text{cash holdings} + 0.715 \times \text{receivables} + 0.547 \times \text{inventory} + 0.535 \times \text{p.p.e.} - \text{total debt}}{\text{total assets}}.$$

Table VI reports the results from the baseline specification with the above modified tangibility measure. For the constrained sample firms, the coefficient on

Table V

Fama–MacBeth Regressions with Tangibility Proxied by Liquidation Value: Controlling for Leverage

This table reports regression coefficients with the associated *t*-statistics (in parentheses) from the Fama–MacBeth (1973) regressions for the sample periods July 1974 to June 2003 (Panels A and B) and July 1986 to June 2003 (Panels C and D). The financial constraints criteria are described in Table I's caption. The dependent variable is the cross-section of monthly returns adjusted for risk using the Fama–French factors. The independent variables are a constant and the cross-section of ln(Size), ln(BEME), Momentum, Book (Market) Leverage, and Tangibility. The Appendix provides definitions of the variables used in the regressions.

	Constant	ln(Size)	ln(BEME)	Momentum	Book Leverage	Market Leverage	Tangibility
Panel A: Asset Size as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value							
Constrained	0.15	−0.40	0.16	0.00	−0.11		2.54
	(0.26)	(3.24)	(1.18)	(1.09)	(1.52)		(3.31)
	0.20	−0.40	0.31	0.00		−0.16	2.53
	(0.35)	(3.33)	(2.55)	(1.19)		(1.57)	(3.30)
Unconstrained	0.58	−0.07	−0.16	0.00	−0.19		−0.21
	(1.45)	(1.98)	(1.85)	(0.82)	(2.71)		(0.41)
	0.27	−0.05	−0.08	0.00		−0.05	0.02
	(0.68)	(1.31)	(0.95)	(0.86)		(0.87)	(0.04)
Panel B: Payout Ratio as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value							
Constrained	−0.05	−0.12	0.11	0.00	−0.05		1.32
	(0.12)	(2.26)	(1.31)	(0.09)	(1.94)		(2.49)
	0.12	−0.13	0.21	0.00		−0.11	1.18
	(0.27)	(2.37)	(2.45)	(0.03)		(2.74)	(2.23)
Unconstrained	0.71	−0.10	0.01	0.00	−0.11		−0.08
	(1.54)	(2.55)	(0.14)	(0.58)	(0.98)		(0.14)
	0.67	−0.09	0.10	0.00		−0.18	−0.01
	(1.46)	(2.34)	(0.96)	(0.49)		(1.72)	(0.02)

(*continued*)

Table V—*Continued*

	Constant	ln(Size)	ln(BEME)	Momentum	Book Leverage	Market Leverage	Tangibility
Panel C: Bond Rating as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value							
Constrained	0.38	−0.18	0.13	0.00	−0.08		1.34
	(0.66)	(2.13)	(1.05)	(0.71)	(1.83)		(2.11)
	0.34	−0.17	0.22	0.00		−0.11	1.44
	(0.61)	(2.09)	(1.84)	(0.68)		(1.83)	(2.26)
Unconstrained	−0.27	0.00	−0.17	−0.01	−0.06		0.35
	(0.42)	(0.03)	(1.15)	(1.06)	(0.88)		(0.43)
	−0.45	0.02	−0.10	−0.01		−0.04	0.50
	(0.71)	(0.41)	(0.70)	(1.17)		(0.29)	(0.63)
Panel D: Commercial Paper Rating as a Financial Constraints Criterion and Tangibility Proxied by Liquidation Value							
Constrained	0.35	−0.16	0.07	0.00	−0.07		1.21
	(0.65)	(2.16)	(0.65)	(0.54)	(2.01)		(2.02)
	0.28	−0.15	0.17	0.00		−0.08	1.33
	(0.54)	(2.06)	(1.51)	(0.52)		(1.47)	(2.19)
Unconstrained	−0.06	0.00	−0.08	−0.01	0.08		0.11
	(0.08)	(0.08)	(0.50)	(2.00)	(0.67)		(0.15)
	−0.49	0.01	−0.20	−0.01		0.43	0.46
	(0.71)	(0.14)	(1.25)	(2.09)		(1.81)	(0.59)

the modified tangibility measure is positive and strongly significant in each of the four classification schemes, ranging from 0.91 (t-statistic of 2.81) for the CP rating scheme to 1.35 (t-statistic of 2.98) for the asset size scheme. The cross-sectional standard deviation of this modified tangibility measure for the constrained sample firms ranges from 0.22 (asset size scheme) to 0.24 (CP rating scheme). This implies that the marginal effect of a one-standard deviation difference in the tangibility measure on the risk-adjusted stock returns ranges from 0.22% per month on average (CP rating scheme) to 0.30% per month on average (asset size scheme), which is of a sizable magnitude and similar to the results for the baseline measure of tangibility. For the unconstrained sample firms, the coefficient on the modified tangibility measure is small and insignificant in three of the four classification schemes.

D. Financial Constraints as a Priced Risk

In contrast to the extensive literature exploring the impact of financial market imperfections on the behavior of corporate investment, relatively little attention has been given to asset pricing implications of financial constraints. However, there is a growing literature investigating whether financial constraints are priced in stock returns. Evidence on the link between financial constraints and asset pricing in these studies is mixed. While Chan and Chen

Table VI

Fama–MacBeth Regressions: Tangibility Proxied by Liquidation Value Less Debt

This table reports regression coefficients with the associated t-statistics (in parentheses) from the Fama–MacBeth (1973) regressions for the sample periods July 1974 to June 2003 (Panels A and B) and July 1986 to June 2003 (Panels C and D). The financial constraints criteria are described in Table I's caption. The dependent variable is the cross-section of monthly returns adjusted for risk using the Fama–French factors. The independent variables are a constant and the cross-section of ln(Size), ln(BEME), Momentum, Book (Market) Leverage, and Tangibility. The Appendix provides definitions of the variables used in the regressions.

Financial Constraints Criteria	Constant	ln(Size)	ln(BEME)	Momentum	Tangibility
Panel A: Constrained Sample Firms					
Asset Size	1.07	−0.36	0.33	−0.01	1.35
	(2.40)	(2.55)	(2.17)	(1.42)	(2.98)
Payout Ratio	0.44	−0.15	0.17	0.00	1.20
	(1.30)	(2.52)	(1.73)	(0.31)	(3.85)
Bond Rating	0.91	−0.20	0.26	0.00	1.04
	(1.84)	(2.24)	(1.91)	(0.84)	(2.99)
Commercial Paper Rating	0.81	−0.17	0.20	0.00	0.91
	(1.74)	(2.09)	(1.65)	(0.65)	(2.81)
Panel B: Unconstrained Sample Firms					
Asset Size	0.34	−0.07	−0.16	0.00	0.28
	(1.19)	(1.84)	(1.66)	(1.05)	(0.88)
Payout Ratio	0.21	−0.07	0.17	0.00	0.95
	(0.66)	(1.53)	(1.32)	(0.88)	(2.28)
Bond Rating	−0.09	0.02	−0.10	−0.01	−0.01
	(0.17)	(0.27)	(0.60)	(1.61)	(0.02)
Commercial Paper Rating	−0.01	0.02	0.06	−0.01	−0.03
	(0.01)	(0.28)	(0.32)	(1.55)	(0.07)

(1991) and Perez-Quiros and Timmermann (2000) find evidence in support of financial constraints being a systematic risk factor, Lamont et al. (2001) find that financially constrained firms earn lower returns on average than unconstrained firms. In contrast to Lamont et al. (2001), who use the index based on Kaplan and Zingales (1997) as a measure of financial constraints, Whited and Wu (2006) construct an index of financial constraints based on GMM estimation of an investment Euler equation. They find financially constrained firms earn higher returns on average, but the difference is statistically insignificant. Campello and Chen (2005) estimate a measure of ex ante risk premium using corporate bonds data, and find that financially constrained firms have significantly higher average bond risk premia than unconstrained firms.

Our findings from the Fama–MacBeth regressions, while clearly consistent with the implicit assumption that financial constraints are priced, do not provide an explicit estimate of the risk premium associated with financial constraints. In order to facilitate a better and more informative comparison of our findings with previous studies, we form a financial constraints factor taking an approach similar to Lamont et al. (2001) and Whited and Wu (2006). In both of these papers, financially constrained firms are hypothesized to be riskier than unconstrained firms, and accordingly, the risk premium associated with financial constraints is measured by the difference in average returns across the portfolios of financially constrained and unconstrained firms. In contrast, our model of corporate investment under collateral constraints implies that (i) financial constraint risk takes the form of exposure to the credit multiplier effect on investment captured by debt capacity, and (ii) only financially constrained firms are exposed to the credit multiplier effect, which increases with debt capacity. These two features of the model suggest that we measure the risk premium associated with financial constraints by the difference in average returns across the portfolios of high and low debt capacity firms constructed within the sample of constrained firms.

We sort the sample of financially constrained firms independently into two size groups (top half and bottom half based on market capitalization) and two tangibility groups (top half and bottom half based on the tangibility measure), and calculate value-weighted returns each month for these four portfolios.[16] Each June of year t, we rebalance the portfolios based on market capitalization in June of year t and the tangibility measure in year $t-1$. Denoting the value-weighted return on these four portfolios as Small/High, Small/Low, Big/High, and Big/Low, our size-controlled financial constraints factor is defined as [(Small/High + Big/High)/2 – (Small/Low + Big/Low)/2]. Since we have four alternative financial constraints criteria and two alternative measures of tangibility, we have eight alternative proxies for the financial constraints factor.

Table VII reports average returns and t-statistics of the financial constraints factors. Given the four alternative firm classification schemes for financial constraint status and two alternative proxies for debt capacity, we have eight financial constraints factor returns. Panel A shows that in all eight cases, the average return on the financial constraint factor is positive and economically significant, ranging from 0.29% to 0.45% per month. In terms of statistical significance, the estimated risk premium is significant in five of the eight cases. Panel B reports average returns and t-statistics of the financial constraints factors formed in the same way as those in Panel A but within the sample of financially unconstrained firms. Our hypothesis predicts that tangibility does not matter for the expected returns of financially unconstrained firms. Consistent with the hypothesis, the average returns are relatively small in magnitude and statistically insignificant in each of the eight cases.

We now investigate whether our financial constraints factor is explained by known empirical proxies for systematic risk in the following simple time-series regression framework:

[16] A potential problem with the portfolio approach to investigating the presence of a risk premium is the difficulty in controlling for other factors that affect average returns and risk premium when forming financial constraints portfolios. We control for size in order to facilitate comparing our results to those of Lamont et al. (2001) and Whited and Wu (2006), who also control for size in a similar way.

Table VII

Financial Constraint Factor Portfolios

This table reports average returns with the associated t-statistics (in parentheses) for the financial constraints factor constructed as follows. We sort the sample of financially constrained firms (Panel A) or financially unconstrained firms (Panel B) independently into two size groups (top half and bottom half based on market capitalization) and two tangibility groups (top half and bottom half based on the tangibility measure), and calculate value-weighted returns each month for these four portfolios. Each June of year t, we rebalance the portfolios based on market capitalization in June of year t and the tangibility measure based on accounting data in year t – 1. Denoting the value-weighted return on these four portfolios as Small/High, Small/Low, Big/High, and Big/Low, our size-controlled financial constraints factor is defined as [(Small/High + Big/High)/2 – (Small/Low + Big/Low)/2]. Since we have four alternative financial constraints criteria and two alternative measures of tangibility, we have eight alternative proxies for the financial constraints factor in each panel. The financial constraints criteria are described in Table I's caption. The sample period is 1973 to 2001 for the asset size and payout ratio criteria and 1985 to 2001 for the bond and commercial paper rating criteria. The Appendix provides definitions of the variables used in the regressions.

	Financial Constraints Criteria			
	Asset Size	Payout Ratio	Bond Rating	CP Rating
Panel A: Size-Controlled Financial Constraints Factor Based on Tangibility within Constrained Sample				
	Tangibility Proxied by Liquidation Value			
Average Return	0.32	0.41	0.32	0.29
t-statistic	(1.95)	(2.43)	(1.52)	(1.22)
	Tangibility Proxied by Liquidation Value less Debt			
Average Return	0.34	0.34	0.45	0.40
t-statistic	(2.12)	(1.98)	(2.45)	(1.64)
Panel B: Size-Controlled Financial Constraints Factor Based on Tangibility within Unconstrained Sample				
	Tangibility Proxied by Liquidation Value			
Average Return	0.03	−0.15	−0.13	−0.18
t-statistic	(0.25)	(1.11)	(0.73)	(1.23)
	Tangibility Proxied by Liquidation Value less Debt			
Average Return	0.00	−0.10	−0.08	−0.14
t-statistic	(0.01)	(0.77)	(0.47)	(1.09)

$$FC_t = \alpha + b_1 MKT_t + b_2 SMB_t + b_3 HML_t + \varepsilon_t. \tag{16}$$

The dependent variable FC_t is the return on the financial constraints factor at t. The independent variables are a constant and Fama and French's (1993) three factors (MKT, SMB, and HML). The market factor, MKT, is the value-weighted return on all NYSE, Amex, and NASDAQ stocks minus the 1-month Treasury bill rate. The size factor, SMB, is constructed by subtracting a large firm portfolio return from a small firm portfolio return, where size is measured by market capitalization. The book-to-market factor, HML, is constructed by

Table VIII

Pricing Financial Constraint Factor Portfolios

This table reports the coefficient estimates, t-statistics, and R^2's from the following time-series regression:

$$FC_t = \alpha + b_1 MKT_t + b_2 SMB_t + b_3 HML_t + \varepsilon_t.$$

The dependent variable *FC* is the average return on the financial constraints factor. The independent variables are a constant and Fama and French's (1993) three factors (*MKT*, *SMB*, and *HML*). The market factor, *MKT*, is the value-weighted return on all NYSE, Amex, and NASDAQ stocks minus the 1-month Treasury bill rate. The size factor, *SMB*, is constructed by subtracting a large firm portfolio return from a small firm portfolio return, where size is measured by market capitalization. The book-to-market factor, *HML*, is constructed by subtracting a low book-to-market portfolio return from a high book-to-market portfolio return. The financial constraints criteria are described in Table I's caption. The sample period is 1973 to 2001 for the asset size and payout ratio criteria and 1985 to 2001 for the bond and commercial paper rating criteria. The Appendix provides definitions of the tangibility measures.

Financial Constraints Criteria	Constant	MKT	SMB	HML	R^2
Panel A: Tangibility Proxied by Liquidation Value					
Asset Size	0.45	−0.01	0.16	−0.40	0.24
	(2.65)	(0.28)	(1.96)	(5.65)	
Payout Ratio	0.60	0.00	0.14	−0.55	0.37
	(3.61)	(0.02)	(2.10)	(8.08)	
Bond Rating	0.44	0.07	0.17	−0.53	0.62
	(2.64)	(1.56)	(2.61)	(9.06)	
Commercial Paper Rating	0.48	0.05	0.03	−0.72	0.62
	(2.61)	(1.14)	(0.55)	(8.94)	
Panel B: Tangibility Proxied by Liquidation Value Less Debt					
Asset Size	0.46	−0.02	0.12	−0.34	0.17
	(2.65)	(0.34)	(1.15)	(4.12)	
Payout Ratio	0.64	−0.09	0.04	−0.64	0.37
	(4.19)	(2.12)	(0.62)	(9.80)	
Bond Rating	0.58	0.02	0.09	−0.48	0.52
	(3.60)	(0.43)	(1.12)	(6.56)	
Commercial Paper Rating	0.65	−0.03	−0.02	−0.79	0.57
	(2.99)	(0.45)	(0.25)	(9.94)	

subtracting a low book-to-market portfolio return from a high book-to-market portfolio return.

Table VIII reports the coefficient estimates, t-statistics, and R^2s from the above time-series regression.[17] In each of the eight cases (four alternative financial constraints criteria and two alternative proxies for tangibility), the estimate for α is both economically and statistically significant. The magnitude of α, which can be interpreted as the pricing error, ranges from 0.44% to 0.65% per month. The low R^2 measures also indicate that the variation in the

[17] The reported t-statistics are computed using Newey and West (1987) standard errors with three lags.

financial constraints factor is not well explained by the Fama–French three-factor model. Including the momentum factor as an additional risk proxy in the regression does not change the main results, as the coefficient on the momentum factor is insignificant and the R^2 does not improve much in each of the eight cases. Overall, the results are consistent with our findings from the Fama–MacBeth regressions and further support our hypothesis. For financially constrained firms, debt capacity captures the exposure to the credit multiplier effect reflected in expected returns, and the risk premium associated with the credit multiplier effect under financial constraints is not captured by other known risk proxies.

E. Financial Constraints and Macroeconomic Conditions

Our finding of a positive risk premium on the financial constraints factor, combined with the evidence that credit constraints vary over the business cycle (Gertler and Hubbard (1988), Gertler and Gilchrist (1994), Kashyap et al. (1994)), suggests a connection between the financial constraints factor portfolio returns and macroeconomic variables likely to reflect changes in credit market conditions. Evidence on the link between financial constraint risk and macroeconomic conditions, however, is mixed. Lamont et al. (2001) find that financially constrained firms are not significantly more sensitive to macroeconomic conditions than unconstrained firms. Gomes, Yaron, and Zhang (2006) find that the shadow costs of external funds, estimated from a production-based asset pricing model augmented with financing frictions, show strong procyclical variation.[18] Both of these findings are contrary to the conventional notion that financing frictions are likely to bind more in economic downturns. Campello and Chen (2005), however, find that the difference between the stock returns of financially constrained and unconstrained firms widens when financial constraints are more likely to bind. They also find that ex ante risk premia associated with financial constraints, estimated from corporate bonds data, show countercyclical variation.

While explicitly investigating how the credit multiplier effect operates through the time-series dynamics of stock returns may shed light on the mixed evidence, doing so is beyond the scope of this paper as our main focus is on the cross-sectional implications. Instead, for the purpose of facilitating comparison with existing studies, we conduct the following simple linear regression tests similar to Lamont et al. (2001) and Campello and Chen (2005) to investigate the link between financial constraints and macroeconomic conditions:

$$FC_t = a + \sum_{i=0}^{2} c_i Macro_{t-i} + \varepsilon_t.$$

[18] Gomes, Yaron, and Zhang (2003) incorporate costly external finance into a general equilibrium model and find that matching the observed equity premium requires procyclical variation of the cost of external funds. Livdan, Sapriza, and Zhang (2006) argue that financial constraints are more binding in economic booms because the stochastic discount factor makes capital investment more procyclical.

We use the following six macroeconomic variables widely used as measures of innovations in information about current and future economic activity, monetary policy, and credit conditions: the change in log of the index of total industrial production, the change in the capacity utilization rate, the change in the log of real M2, the change in the log of real commercial and industrial loans at all commercial banks, the change in the spread between the Bank Prime Loan rate and the 10-year Treasury rate, and the change in the spread between the 6-month commercial paper rate and 6-month Treasury bill rate.

Table IX reports both the contemporaneous coefficient and the sum of all three coefficients along with the associated p-values (in parentheses). We find significant correlations only with the change in the log of real commercial and industrial loans at all commercial banks, $\triangle$*Business Loan*. The sum of the coefficients is significantly positive at the 5% level in the payout ratio and CP

Table IX

Financial Constraint Factor Portfolios and Macro Variables

This table reports the coefficient estimates and p-values (in parentheses) from the following regression:

$$FC_t = a + \sum_{i=0}^{2} c_i Macro_{t-i} + \varepsilon_t.$$

The dependent variable FC_t is the return on the financial constraints factor at t. The independent variables are a constant and selected macroeconomic variables. $\triangle$Industrial Production is the change in the log of the index of total industrial production; $\triangle$Capacity Utilization is the change in the capacity utilization rate; $\triangle$M2 is the change in the log of real M2; $\triangle$Business Loan is the change in the log of real commercial and industrial loans at all commercial banks; $\triangle$Loan Spread is the change in the spread between the Bank Prime Loan rate and the 10-year Treasury rate; $\triangle$CP Spread is the change in the spread between the 6-month commercial paper rate and 6-month Treasury bill rate. The financial constraints criteria are described in Table I's caption. The sample period is 1973 to 2001 for the asset size and payout ratio criteria and 1985 to 2001 for the bond and commercial paper ratings criteria. The sample period for the regression with $\triangle$CP Spread ends in August 1997 as the 6-month commercial paper rate data series is discontinued.

	Financial Constraints Criteria							
	Asset Size		Payout Ratio		Bond Rating		CP Rating	
	c_0	$\sum_{i=0}^{2} c_i$	c_0	$\sum_{i=0}^{2} c_i$	c_0	$\sum_{i=0}^{2} c_i$	c_0	$\sum_{i=0}^{2} c_i$
$\triangle$Industrial Production	−0.29	−0.32	−0.44	−0.39	−0.18	0.14	−0.02	0.64
	(0.20)	(0.28)	(0.06)	(0.21)	(0.67)	(0.80)	(0.96)	(0.34)
$\triangle$Capacity Utilization	0.00	0.00	−0.01	−0.01	0.00	0.00	0.00	0.00
	(0.19)	(0.23)	(0.05)	(0.12)	(0.64)	(0.90)	(0.60)	(0.83)
$\triangle$M2	0.11	0.05	0.85	0.74	0.12	0.39	0.32	0.50
	(0.77)	(0.91)	(0.02)	(0.10)	(0.83)	(0.57)	(0.61)	(0.53)
$\triangle$Business Loan	0.12	0.67	0.79	1.04	0.51	1.25	0.53	1.69
	(0.73)	(0.14)	(0.03)	(0.03)	(0.29)	(0.06)	(0.33)	(0.02)
$\triangle$Loan Spread	0.00	0.00	0.00	0.00	−0.01	0.01	0.00	0.01
	(0.96)	(0.71)	(0.93)	(0.58)	(0.39)	(0.59)	(0.81)	(0.50)
$\triangle$CP Spread	0.01	0.02	0.01	0.00	−0.01	−0.01	0.00	0.02
	(0.07)	(0.14)	(0.30)	(0.89)	(0.41)	(0.61)	(0.83)	(0.56)

rating schemes, and at the 10% level in the bond rating scheme. In general, however, high tangibility firms' returns are not significantly more sensitive to macroeconomic conditions than low tangibility firms' returns, as the coefficient estimates are small and insignificant for all the other variables.

While the results are not supportive of our hypothesis, it is important to note that this simple linear framework may not be appropriate for investigating the dynamics of the credit multiplier effect. For example, Perez-Quiros and Timmermann (2000) explicitly model the conditional distribution of stock returns to vary with the state of the economy using a Markov switching model with time-varying transition probability. They show that small (in terms of market capitalization) firms display a higher degree of asymmetry in their risks across the business cycle, and that this asymmetry translates into a higher sensitivity of the small firms' expected stock returns with respect to variables that measure credit market conditions. They interpret the finding to be in support of imperfect capital market theories in the sense that small firms are more likely financially constrained due to little collateral and restricted access to capital markets, and hence, they are likely to be more vulnerable to tighter credit market conditions and economic downturns. Investigating the time-series relation between our financial constraints factor proxies and credit market conditions in a more sophisticated framework such as that of Perez-Quiros and Timmermann would be an important next step toward a better understanding of the credit multiplier effect on stock returns. We leave this task for future research.

IV. Conclusion

This paper investigates whether the effects of financial status on corporate investment behavior, predicted by theories of capital market imperfections and supported by empirical evidence, are reflected in the stock returns of manufacturing firms. Based on a simple model of corporate investment under collateral constraints, we develop a testable hypothesis that high debt capacity firms are likely to have higher exposure to the risk associated with changes in the availability of internal and external funds for investment. If such risk is priced by the market, then we should expect high debt capacity firms to earn higher returns on average than low debt capacity firms, after controlling for other risk characteristics that determine the cross-section of stock returns. On the other hand, our hypothesis suggests that for financially unconstrained firms whose level of investment is independent of debt capacity, the cross-sectional differences in debt capacity have no systematic relation with the cross-section of stock returns.

Using four alternative firm classification schemes, we test the predictions about the differential marginal effect on stock returns across financially constrained and unconstrained firms in the Fama–MacBeth regression framework using a sample of manufacturing firms. Our findings strongly support the predictions. Debt capacity is an important determinant of the cross-section of financially constrained firms' stock returns, over and above theoretical and empirical risk proxies such as beta, size, book-to-market, leverage, and momentum. The positive marginal impact of debt capacity on financially constrained firms' stock returns is also economically significant. In contrast, debt capacity has no systematic relation with the cross-section of financially unconstrained firms' stock returns.

We also form a financial constraints factor in the form of zero-cost portfolios and measure the risk premium associated with financial constraints by the difference in average returns across the portfolios of high and low debt capacity firms constructed within the sample of constrained firms. We find that the average return on the financial constraints factor is both economically and statistically significant, and its variation is not well explained by conventional risk proxies such as size, book-to-market, and momentum.

Taken together, the findings support the cross-sectional predictions of the models of imperfect capital markets such as the credit multiplier effect of Kiyotaki and Moore (1997) and the financial accelerator effect of Bernanke et al. (1996). The extant empirical research on these effects has primarily focused on the predictions regarding corporate investment behavior, with relatively little attention given to their asset pricing implications. This paper complements and extends the prior findings by providing evidence that the cross-sectional differences in corporate investment behavior arising from the presence of credit constraints are reflected in the stock returns of manufacturing firms.

Appendix

All variables used in the regressions are constructed using COMPUSTAT and CRSP data and they are defined as follows. For the firms classified as either constrained or unconstrained in year $t-1$, ln(*Size*) is the logarithm of the market value of equity at the end of June in year t from CRSP, and ln(*BEME*) is the logarithm of the book-to-market ratio at the end of year $t-1$. *Momentum* is the sum of monthly returns for each firm for the rolling 6-month window ending 2 months prior to the month of the dependent variable return. *Book (Market) Leverage* is defined as the ratio of the book value of short- and long-term debt to the book (market) value of equity at the end of year $t-1$. *Tangibility* is an expected asset liquidation value for a firm at the end of year $t-1$, defined as follows.

$$\text{Tangibility} = \frac{\text{cash holdings} + 0.715 \times \text{receivables} + 0.547 \times \text{inventory} + 0.535 \times \text{PPE}}{\text{total assets}}.$$

An alternative proxy for tangibility is an expected asset liquidation value for a firm at the end of year $t-1$ less the book value of total debt (short-term and long-term) and scaled by the book value of total assets as follows:

$$\text{Tangibility} = \frac{\text{cash holdings} + 0.715 \times \text{receivables} + 0.547 \times \text{inventory} + 0.535 \times \text{PPE} - \text{total debt}}{\text{total assets}}.$$

Firm characteristics summarized in Tables II and III are defined as follows. Asset size is defined as the book value of total assets (in million dollar). Payout ratio is defined as the ratio of total distributions (dividends plus stock repurchases) to net income. Interest coverage is defined as the ratio of operating income before depreciation to interest expense. Investment is defined as the ratio of capital expenditures to beginning-of-period capital stock (lagged property, plant, and equipment). Q (Tobin's Q) is computed as the ratio of market value of assets to the book value of assets, where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes. *ME* is the market value of equity from CRSP. *BEME* is the book-to-market ratio, computed as the COMPUSTAT book value of common equity divided by the market value of equity. Debt-to-Asset Ratio is defined as the ratio of the book value of total debt (short-term and long-term debt) to the book value of total assets, and Profitability is defined as the ratio of *EBITDA* to the book value of total assets. Annual Excess Return is the sum of 12-month stock returns in excess of the T-bill rate where the 12-month period is from July of year t to June of year $t + 1$.

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