Margin Constraints and the Security Market Line

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Abstract

Between the years 1934 and 1974, the Federal Reserve actively managed the initial margin requirement in the U.S. stock market. I use this exogenous variation in margin requirements to test whether funding constraints affect the security market line, i.e. the relation between betas and expected returns. Consistent with the theoretical predictions of Frazzini and Pedersen (2013), but somewhat contrary to their empirical findings, I find that tighter funding constraints result in a flatter security market line. My results provide strong empirical support for the idea that leverage constraints faced by investors may, at least partially, help explain the empirical failure of the capital asset pricing model.

JEL Classification: G12, G14, N22.
Keywords: Funding frictions, security market line, margin regulation.

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1 Introduction

Why is the return difference between high and low beta stocks much smaller than what is predicted by the capital asset pricing model? One of the first explanations to this question is provided by Black (1972) who shows that in a market with no risk-free borrowing the security market line having a slope that is less than the expected market excess return. The assumption of investors' absolute inability to borrow, however, does not square with market realities. More recently, Frazzini and Pedersen (2013) provide a more realistic treatment of the effects of borrowing constraints on the cross-sectional price of risk. They present a model with overlapping generations of investors where the slope of the equilibrium security market line depends negatively on the tightness of the investors' borrowing constraints. They use the model to motivate a trading strategy that benefits from the flatness of the beta–expected return relation and show that such strategy earns positive returns in many asset markets. They also show that these returns are correlated with the spread between Eurodollar and Treasury bill rates, i.e. the TED spread. This correlation, however, is empirically negative whereas the model would predict a positive correlation. Frazzini and Pedersen (2013) rationalize the negative correlation as the level of TED spread being a measure for the change in funding conditions rather than a measure of the funding conditions themselves.[1] However, the TED spread may not be an optimal measure of exogenous funding constraints faced by investors. First, it is more a measure of the costs of funding rather than a constraint on the amount of funding. Second, the TED spread is likely affected by investors' expectations and risk preferences which may also affect the security market line without any mechanism involving funding constraints.

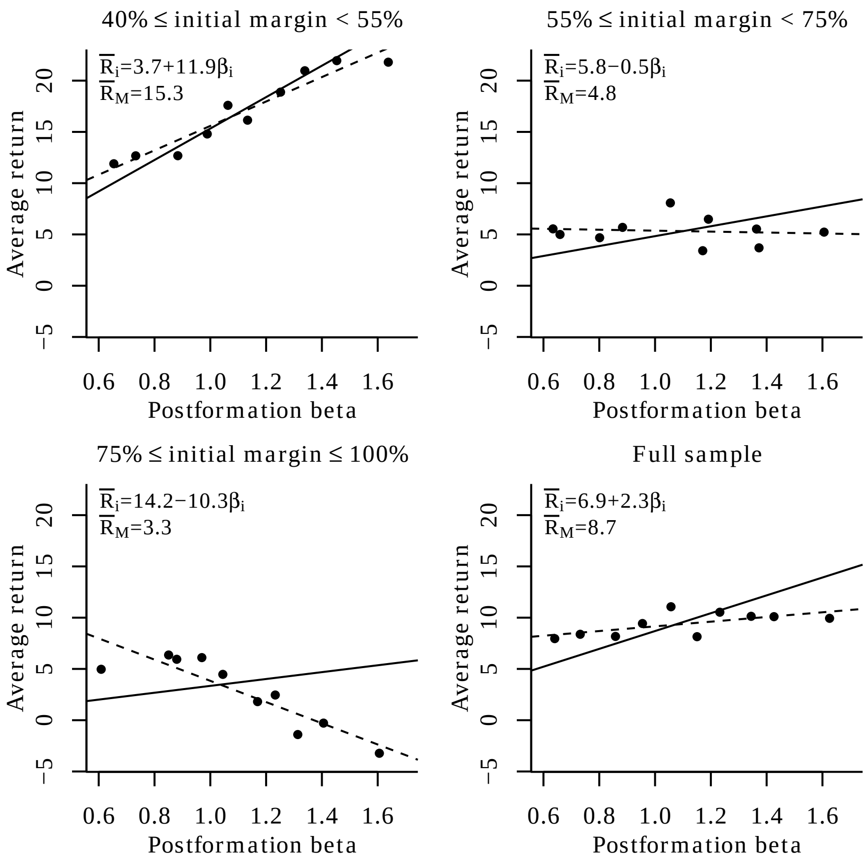
In this paper, I use an exogenous measure of borrowing constraints and provide strong and robust empirical evidence in support of the theoretical prediction that tighter constraints result in a flatter security market line. My measure of borrowing constrains is based on the active management of the minimum initial margin requirement by the Federal Reserve. Pursuant to the Securities Exchange Act of 1934, the Federal Reserve sets the initial margin required when purchasing common stock on credit in US stock exchanges.[2] Between October 1934 and January 1974, this margin requirement was changed 22 times ranging between 40% and 100%. This exogenous, frequent, and sizable variation in a legal borrowing constraint provides an excellent setting to test whether such constraints affect asset pricing.

The results are as follows. First, I show that the margin requirement does not have an effect on the riskiness of the stock market but does have a strong effect on investors' access to credit. These findings confirm that the federally set initial margin is a good proxy for borrowing constraints. Second, and most importantly, I find that the slope of the security market line is

[1] Earlier literature (e.g., Asness, Moskowitz, and Pedersen, 2013, Moskowitz, Ooi, and Pedersen, 2012, Cornett, McNutt, Strahan, and Tehranian, 2011, Ranaldo and Söderlind, 2010, Gârleanu and Pedersen, 2011, Brunnermeier and Pedersen, 2009, and Brunnermeier, Nagel, and Pedersen, 2009) uses the the TED spread as a measure of funding liquidity, not the change therein.

[2] Initial margin requirement dictates the minimum value of collateral needed when purchasing stock. For example, a 40% initial margin requirement means that an investor can borrow up to 60% of the cost of a new stock purchase.

Figure 1: Initial margin requirement and security market line.
This graph depicts the empirical relation between beta and average excess return in different initial margin requirement environments. The test assets are ten beta-sorted value-weighted portfolios. The solid line depicts the empirical security market line and the dashed line gives the theoretical security market line predicted by the CAPM. The top left panel includes those 197 months where the initial margin requirement is between 40% and 55% (183 months), the top right panel includes months where the requirement is between 55% and 75%, and the bottom left panel includes months where the requirement is above 75% (112 months). The lower left panel presents the security market lines for the full sample of 492 months from 10/1934 to 9/1975.



negatively dependent on the prevailing margin requirement. Similarly, the intercept of the beta–return relation is positively dependent on the margin requirement. These findings are in perfect accordance with the theoretical prediction of Black (1972) and Frazzini and Pedersen (2013). Figure 1 provides a simple illustration of these main results. It depicts the security market lines for three sub-samples of data: periods of low, medium, and high initial margin requirement. The difference between the security market lines during low and high margin requirement is striking. When the margin requirement is low (between 40% and 55%) the empirical security market line runs very near its CAPM prediction. During high (75%-100%) initial margin requirement, the empirical security market line differs hugely from that predicted by the CAPM and actually has a negative slope. This graph provides simple but powerful summary of the main result.

Third, using different test assets, beta estimation periods, and control variables, I show that the results are very robust. In all specifications the effects of borrowing constraints on the security market line have the predicted sign and are statistically significant. Fourth, I regress the betting against beta strategy returns on the initial margin requirement and find that, consistent with my earlier results and the theoretical predictions, the returns are positively dependent on the borrowing constraints.

These results are somewhat at odds with those reported by Frazzini and Pedersen (2013). As mentioned above, they find a negative correlation between the strategy returns and their measure of funding constraints which would imply that the security market line is indeed steeper during more binding borrowing constraints, not flatter as is predicted by their model. My results clearly show that tighter margin constraints result in a flatter security market line and higher returns to the betting against beta strategy, consistent with the model.

This work is related to empirical papers examining factors that affect the shape of the security market line. Cohen, Polk, and Vuolteenaho (2005) test whether investors suffer from money illusion (Modigliani and Cohn, 1979) by examining the effect of inflation on the security market line. They find a negative relation between lagged inflation and the security market line slope. The empirical design of this paper follows that of Cohen, Polk, and Vuolteenaho (2005), and the robustness check section shows that the results presented here are also robust to controlling for inflation. Hong and Sraer (2012) show that aggregate disagreement affects both the slope and concavity of the beta-expected return relation. Savor and Wilson (2013) show that the security market line is much steeper on macroeconomic announcement days than on non-announcement days. This paper is also related to the literature examining the effects of the federal margin regulation on stock market volatility. Starting from Officer (1973), the nearly unanimous conclusion of these studies is that margin regulation has no impact on market volatility. Kupiec (1997) provides an extensive review of this literature.

The rest of the paper is organized as follows. Section 2 provides a theoretical motivation for the paper, Section 3 introduces the data used in the study, and Section 4 presents the empirical results. Section 5 concludes.

2 Asset pricing with margin constraints

The idea that portfolio constraints affect the relation between betas and expected returns is not new. Black (1972) shows that in a model with no borrowing the security market line is flatter than in the CAPM. A more realistic assumption, however, would be that at least some investors can borrow but their maximum level of leverage is exogenously restricted. This is the key assumption in the model of Frazzini and Pedersen (2013) which also serves as the main theoretical motivation for this paper. Their model features overlapping generations of investors who face a portfolio constraint which dictates that their total investment in risky securities cannot exceed an exogenously given fraction, $1/m$, of their total wealth. For example, if this fraction is equal to one, the investor cannot borrow in the risk-free asset as in Black (1972). If $1/m < 1$, the investor has to hold part of her wealth in the risk-free asset. Similarly, $1 < 1/m < \infty$ implies that the investor can use leverage but faces a margin constraint that limits the maximum amount of leverage.

Intuitively, portfolio constraints will affect asset pricing in the following manner. In an unconstrained CAPM world (where $m = 0$ and $1/m = \infty$), an investor with very low risk aversion borrows heavily in the risk-free asset and invests in the market portfolio. However, in the constrained world, she is not able to do so as the maximum amount of leverage is limited by the margin requirement. As she is no longer able to achieve her desired risk level by leveraging her investment, she does so by investing in a portfolio with beta greater than one, not the market portfolio. Such behavior by constrained investors seeking higher portfolio risk creates higher demand for high beta stocks than in the unconstrained CAPM case. In equilibrium, this results in higher prices and lower expected returns for high beta stocks. Similarly, in the constrained case, the demand for low beta stocks will be lower and their expected return higher than in the unconstrained case. This makes the security market line flatter in presence of borrowing constraints.

Formally, the security market line under margin constraints is given by

$$E\left(r_i^e\right) = \psi + \beta_i \left(E\left(r_M^e\right) - \psi\right), \tag{1}$$

where ψ is the average Lagrange multiplier in the agents' optimization program. It measures the tightness of the margin constraint: the higher the value of ψ the stricter the constraint. It is straightforward to see from Equation (1) that, other thing being equal, tighter margin constraints result in a higher intercept and a lower slope of the security market line.

Frazzini and Pedersen (2013) mainly use the model to motivate a "betting against beta" (BAB) trading strategy that goes long a portfolio of low beta securities and shorts high beta securities. The long and short legs are weighted by the reciprocals of their betas to make the resulting portfolio beta neutral. In their empirical work, they show that such strategy yields positive risk-adjusted returns in a number of asset markets.

To connect the profitability on their trading strategy to funding constraints, the authors regress the BAB strategy returns on the Treasury-over-Eurodollar spread (TED spread). The TED spread is often used as a measure of funding constraints. [3]. As the BAB returns are higher when the security market line is flatter, which again according to the theory is a result of tighter funding constraints, one should expect to find a positive correlation between the TED spread and the profitability of betting against beta. This, however, is not exactly what Frazzini and Pedersen (2013) find. On the contrary, they find a negative and statistically significant correlation between the lagged level of the TED spread and the BAB returns, which seems to be in direct contrast with the theoretical prediction. They also find a negative and significant correlation between the contemporaneous change in the TED spread and the BAB returns. They interpret these results as both variables being proxies for the change in funding conditions, i.e. that higher lagged level of and contemporaneous change in the TED spread imply tightening funding constraints. This may be a reasonable interpretation of the change in the TED spread but not necessarily for the level of the spread as it is commonly used as a measure of funding conditions, not a measure of change in funding conditions.[4]

The TED spread, however, is not an optimal measure for exogenous margin constraint which is the key ingredient of the theoretical model. As a difference between two yields, the TED spread itself is derived from asset prices and is hence an outcome of the investors' portfolio choice problem. Thus, for example, changes in investors' risk preferences or expectations could simultaneously affect both the TED spread and the shape of the security market line without any mechanism involving funding constraints. This is especially critical when contemporaneous changes in the TED spread are used to explain asset returns. Further, the TED spread measures the cost of leverage, not a constraint on leverage. However, in the theoretical model what affects the security market line is the constraint on maximum leverage, not the cost of obtaining that leverage. Hence, an exogenous measure of margin constraints is needed to properly test whether such constraints affect the shape of the security market line as is predicted by the model. In this paper I use a truly exogenous measure of margin constraints that is not based on asset prices but on regulatory actions taken by the Federal Reserve.

[3]Papers using the TED spread as a measure of funding constraints include Asness, Moskowitz, and Pedersen (2013), Moskowitz, Ooi, and Pedersen (2012), Cornett, McNutt, Strahan, and Tehranian (2011), Ranaldo and Söderlind (2010), Gârleanu and Pedersen (2011), Brunnermeier and Pedersen (2009), and Brunnermeier, Nagel, and Pedersen (2009).

[4]In unreported analyses I find that the lagged level of the TED spread has no significant effect on changes in the margin credit extended to their customers by NYSE brokers and dealers. I regress changes in debt relative to market capitalization on the lagged TED spread, the contemporaneous change in the spread, and controls (lagged market return, volatility, and skewness). The coefficient of the lagged TED spread is not statistically significantly different from zero in any specification. The coefficient of the contemporaneous change in the TED spread is positive and marginally significant indicating that increases in margin debt coincide with increases in the TED spread contrary to the interpretation of Frazzini and Pedersen (2013) that increases in the TED spread result in contemporaneous tightening of credit conditions. The positive correlation can be seen as an indication of causality issues: it is possible that an increase in the debt levels leads to a simultaneous increase in the spread.

3 Data

3.1 Margin regulation in the U.S. stock market

My measure of leverage constraints is the minimum initial margin required when purchasing stocks on credit in U.S. stock exchanges. Prior to 1934, the NYSE and other exchanges were responsible for regulating how much credit brokers can extend to their clients to purchase and carry common stocks. The Securities Exchange Act of 1934 transferred this responsibility to the Board of Governors of the Federal Reserve System. This move reflected the widely-held view that too low margin requirements had fueled the stock market boom in the 1920's and that subsequent margin calls had exacerbated the market crash in 1929 (Hsieh and Miller, 1990). There was also a concern that loans extended to investors could crowd out loans to businesses and farmers (Schwert, 1989).

Pursuant to the Securities Exchange Act, The Federal Reserve regulates margin borrowing by setting a minimum level for the initial margin that the lenders must require.[5] Initial margin corresponds to the amount of cash, or other collateral, investors must put down when purchasing stock. For example, a 40% initial margin requirement means that investors can borrow up to 60% of the cost of a new investment in stock. The Federal Reserve does not regulate the maintenance margin which dictates the minimum amount of collateral required at every point in time to carry the investment. Regulation of the maintenance margin is left to the exchanges. Also, lenders are allowed to require higher initial margins than what is set in the federal regulation.

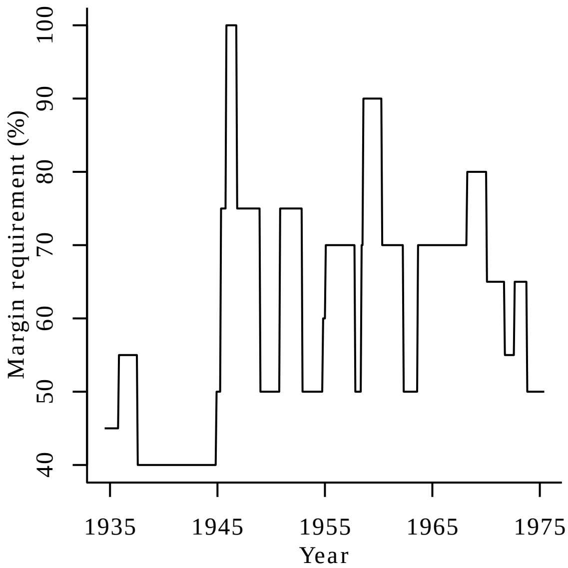
The Federal Reserve mandated margin requirements became effective on 10/1/1934 when Regulation T set the initial margin requirement at 45%. Subsequently, the requirement was changed 22 times between February 1936 and January 1974 and ranged between 40% and 100%. The Federal Reserve has not changed the margin requirement from 50% since March 1974. The time series of the margin requirement is plotted in Figure 2.[6] As is evident from the figure, the initial margin requirement shows frequent and substantial variation over time. This is important for my empirical work as the strong variation in the margin requirement helps to identify the effect funding constraint have on the security market line. Because the margin requirement has not been changed since 1974, I present all my results for the 41-year sample period from 10/1934 to 9/1975.

A number of academic papers have studied the effects of the margin requirement, mainly on stock market volatility. Initially, Officer (1973) finds no evidence that the margin regulation

[5] The margin requirements are set by the Federal Reserve via its Regulations T, U, and G, which govern the lending by brokers and dealers, banks, and other lenders, respectively.

[6] The initial margin requirement was changed on 2/1/1936 to 55%, on 11/1/1937 to 40%, on 2/5/1945 to 50%, on 7/5/1945 to 75%, on 1/21/1946 to 100%, on 2/1/1947 to 75%, on 3/30/1949 to 50%, on 1/17/1951 to 75%, on 2/20/1953 to 50%, on 1/4/1955 to 60%, on 4/23/1955 to 70%, on 1/16/1958 to 50%, on 8/5/1958 to 70%, on 10/16/1958 to 90%, on 7/28/1960 to 70%, on 7/10/1962 to 50%, on 11/6/1963 to 70%, on 6/8/1968 to 80%, on 5/6/1970 to 65%, on 12/6/1971 to 55%, on 11/24/1972 to 65%, and on 1/3/1974 to 50%. Between 10/1/1935 and 1/31/1936 the margin requirement was 25%-45% and between 2/1/1936 and 3/31/1936 the requirement was 25%-55%. In accordance with the previous literature and the Federal Reserve and NYSE statistics, I use the highest values (i.e. 45% and 55%, respectively) for these time periods. In all other periods, the margin requirement was expressed as a single figure.

Figure 2: Initial margin requirement.
This graph gives the level of initial margin required on positions in listed U.S. equities. The initial margin requirement is set by the Federal Reserve Board via Regulation T.



would have an effect on stock market volatility. The 1987 stock market crash reinvigorated the discussion whether the Federal Reserve should again take a more active stance in managing the margin requirement. This discussion was further fueled by the finding of Hardouvelis (1990) that a higher margin requirement results in a lower stock market volatility. This finding has, however, been disputed by a number of authors, most notably Hsieh and Miller (1990) who attribute the finding to flaws in the tests. An extensive review by Kupiec (1997) concludes that there is no undisputed evidence that margin regulation would affect stock market volatility. Panel A of Table 1 provides a simple confirmation of these results. I regress the level and change in monthly volatility of daily market returns on lagged level of margin requirement, lagged market return as well as lagged volatility and skewness of daily market returns.[7] In all specifications, the coefficient of the initial margin is not statistically significant confirming earlier results that margin regulation does not affect market volatility.[8]

The fact that the margin regulation does not have an effect on the fundamental riskiness of the stock market is important for the current study. Below, I show that higher margin requirement results in a flatter security market line, i.e. relation between beta and expected return. If the higher margin was also associated with a less risky stock market, this finding could be justified by investors requiring a lower risk premium during less risky times. However, as the

[7] I report results using three lags of each control variable. The results are robust to using other lag lengths.
[8] In an unreported analysis I also find that the margin regulation has no effect on the skewness of the stock market returns.

Table 1: Margin regulation, volatility, and credit.
This table presents the results of regressing measures of stock market volatility (Panel A) and margin credit (Panel B) on the lagged margin requirement and controls. Volatility is measured by the monthly standard deviation of daily market excess returns. Margin credit is measured by the amount of credit extended by NYSE brokers and dealers to their customers as a percentage of the market capitalization of all NYSE listed firms. The margin credit data is de-trended using a Hodrick-Prescott filter with $\lambda = 10^6$. In columns 1 and 2, the dependent variable is the level of volatility or credit, and in columns 3 and 4, the change in these variables. Controls are three lags of monthly market excess return and standard deviation and skewness of daily market returns. Newey and West (1987) t-statistics are reported in parentheses and R^2s are adjusted for degrees of freedom. The sample period 10/1934-9/1975 with 492 monthly observations.

PANEL A: Stock market volatility	Level		Change	
	(1)	(2)	(3)	(4)
Constant	15.446	4.801	-0.211	1.600
	(4.37)	(3.77)	(-0.55)	(2.20)
Margin	-0.068	-0.018	0.003	-0.001
	(-1.30)	(-1.21)	(0.53)	(-0.13)
Controls	No	Yes	No	Yes
R^2	0.025	0.437	-0.002	0.072
PANEL B: Margin credit	Level		Change	
	(1)	(2)	(3)	(4)
Constant	0.233	0.430	0.027	0.055
	(2.00)	(3.24)	(1.41)	(2.62)
Margin/100	-0.394	-0.491	-0.048	-0.056
	(-2.30)	(-3.03)	(-1.63)	(-2.27)
Controls	No	Yes	No	Yes
R^2	0.079	0.153	0.002	0.060

margin regulation has no impact on the riskiness of the market my findings below support the hypotheses of funding constraints faced by investors having an impact on the security market line.

In addition to not having an impact on market riskiness, the margin regulation should affect the investors' ability to borrow in order to finance their stock purchases for the margin requirement to be a good proxy of the funding constraints faced by investors. I examine this by regressing the level of and the change in the credit extended to their customers by NYSE brokers and dealers on lagged margin requirement and controls. The data on NYSE margin credit is constructed by combining data from Federal Reserve Board (1976a,b), and the NYSE Facts and Figures web site.[9] To get a relative measure of margin credit, I divide this time series by the total market capitalization of the NYSE listed companies. As there is a clear non-linear trend in the relative margin credit—especially in the beginning of the sample period—I de-trend the time series by applying a Whittaker-Hordick-Prescott filter (Whittaker, 1922, and Hodrick and Prescott, 1997) with a smoothing parameter $\lambda = 10^6$. Panel B of Table 1 presents the results of regressing the level of and the change in the de-trended relative credit on the lagged margin requirement and controls. I use the same controls as in Panel A the table, i.e. three lags of market return, volatility, and skewness. The results clearly indicate that margin regulation has the expected effect on investors' access to credit. During period of high initial margin requirements margin credit levels and changes are lower than during periods of lower margin requirements.

The results presented above, that margin regulation does affect investors ability to leverage their investments but not the fundamental riskiness of the stock market, indicate that the Federal Reserve mandated initial margin requirement is a suitable proxy for investor funding constraints. Moreover, as an exogenous variable it is not affected by the investors' expectations or preferences. In Section 4, I show that the security market line is flatter during times when the margin requirement is high. Before that, I review the stock market data used in this study and the construction of the security market line.

3.2 Stock market data

The methods employed in this paper closely follow those of Cohen, Polk, and Vuolteenaho (2005). I first sort stock into portfolios based on their historic betas. Then, for every month, I estimate the cross-sectional relation between the portfolios' ex ante betas and realized returns. This yields time series of security market line intercepts and slopes. Finally, I regress these intercepts and slopes on the prevailing initial margin requirement and controls. The results clearly indicate that a high initial margin requirement results in a low security market line slope and a high intercept, consistent with the theoretical predictions of Black (1972) and Frazzini and Pedersen (2013).

[9] The margin debt is constructed by chaining the following time series: "customers' debit balances (net)" in Table 143 in Federal Reserve Board (1976a) for 10/1934-12/1941, "customer credit, net debit balances with NYSE firms" in Table 12.23 in Federal Reserve Board (1976b) for 1/1938-12/1967, and "margin debt" from NYSE Facts and Figures online database (http://www.nyxdata.com/nysedata/asp/factbook/main.asp) for 1/1959-9/1975. The three data sources partially overlap each other allowing me to check that the data is consistent across the sources.

As the goal is to study the the relation between CAPM betas and returns, I first construct a set of test assets that has a large spread in terms betas. For every month, I calculate betas for all NYSE, NASDAQ, and AMEX listed common stocks of U.S. domiciled corporations in the CRSP file by regressing the stocks' monthly returns over the past three years on the value-weighted CRSP index return. I then rank the stocks on the basis of the estimated betas and form 20 equally sized portfolios. For example, the first portfolio contains the five percent of stocks with lowest betas.

Second, I calculate monthly betas for the 20 beta-sorted portfolios by regressing the past 36 monthly returns of the value-weighted portfolios on the value-weighted CRSP index return. These portfolios seem to provide a set of test asset that have a wide range of postformation betas. The estimated beta of the first portfolio ranges between 0.2 to 1.0 while that of the 20th portfolio takes values between 1.2 to 2.2. The difference between highest and lowest betas has an average of 1.2 and ranges between 0.6 and 1.9.

Third, I estimate the cross-sectional relation between ex ante betas and returns each month. I do this by regressing portfolio returns during month t on portfolio betas estimated using data from month $t-36$ to $t-1$. This way, there is no mechanic connection between the dependent and independent variables in the regression. These regressions yield monthly time series of slope and intercept coefficients. The intercept and slope can also be seen as excess returns on two portfolios and expressed as

$$\begin{bmatrix} r^e_{intercept,t} \\ r^e_{slope,t} \end{bmatrix} = \left[\begin{pmatrix} \mathbf{1} & \hat{\beta}_{t-1} \end{pmatrix}' \begin{pmatrix} \mathbf{1} & \hat{\beta}_{t-1} \end{pmatrix} \right]^{-1} \begin{pmatrix} \mathbf{1} & \hat{\beta}_{t-1} \end{pmatrix}' \mathbf{r}^e_t, \tag{2}$$

where $\mathbf{1}$ is a vector of ones, $\hat{\beta}_{t-1}$ is a vector of beta estimates using data up to month $t-1$ and $\mathbf{r}^e_t$ is the vector containing the portfolios' month t excess returns. The intercept portfolio is unit investment with a zero ex ante beta, whereas the slope is zero investment portfolio with unit beta.

Table 2 gives the descriptive statistics of the key variables used in this study: the initial margin requirement, security market line intercept and slope, and the market excess return. A few interesting observations arise from Table 2. First, the average intercept is large positive and the average slope (0.22) is far smaller than the average market excess return (0.74) indicating that the security market line over the sample period in question is flatter than predicted by the CAPM. Second, the security market line intercept is positively correlated with the initial margin whereas the slope has a negative correlation with the margin. These univariate results are consistent with the prediction that stricter funding constraints result in a flatter security market line. Third, the correlation between the margin requirement and market returns is relatively low so that there should be no concerns of multicollinearity in regressions where both are included as explanatory variables.

Table 2: Descriptive statistics.
Descriptive statistics for key variables used in the paper. *Margin* is the minimum initial margin requirement set by the Federal Reserve Board's Regulation T. $r^e_{intercept}$ and r^e_{slope} are the monthly security market line intercept and slope. They are constructed by regressing monthly the cross-section of test asset excess returns on lagged estimated betas. r^e_M is the market excess return. The sample period is 10/1934-9/1975, 492 monthly observations.

	Margin	$r^e_{intercept}$	r^e_{slope}	r^e_M
Mean	61.24	0.57	0.22	0.74
Standard deviation	15.67	3.99	5.96	4.67
Skewness	0.27	0.03	0.91	-0.40
Excess kurtosis	-0.72	4.39	5.92	3.55
25%	50	-1.56	-3.41	-1.85
Median	65	0.86	0.02	1.07
75%	70	2.15	2.36	3.09
Correlation with				
$r^e_{intercept}$	0.09			
r^e_{slope}	-0.14	-0.60		
r^e_M	-0.09	0.11	0.73	

4 Results

4.1 Margin requirement and security market line

To test whether margin constraints have an effect on the beta–expected return relation, I regress the time series of the slope and intercept coefficients on the beginning-of-month initial margin requirement. As it is obvious that the market return will affect at least the slope coefficient, I also include the return to the CRSP value-weighted index as an explanatory variable. Formally, I run the following two regressions:

$$\begin{aligned} r^e_{intercept,t} &= a_1 + b_1 margin_{t-1} + c_1 r^e_{M,t} + u_{1,t} \\ r^e_{slope,t} &= a_2 + b_2 margin_{t-1} + c_2 r^e_{M,t} + u_{2,t}. \end{aligned} \tag{3}$$

The results of these regressions are reported in Table 3.

The first column of Table 3 gives the main result of this paper. The coefficient of the prevailing initial margin requirement in the slope regression (b_1) is equal to 0.028 and is statistically significant with a t-statistic of 2.4. The effect of the initial margin on the security market line slope (b_2) is statistically significantly negative: -0.030 with a t-statistic equal to -2.5. These results show that higher margin requirement results in the security market line having a higher intercept and flatter slope, exactly in line with the theoretical predictions in Equation (1).

It is important to note that these results differ from those presented by Frazzini and Pedersen (2013) regarding the relation between funding constraints and the slope of the security market

Table 3: Basic results.
This table presents the results of regressing monthly security market line intercept and slope on the lagged initial margin requirement and the contemporaneous market excess return:

$$r^e_{intercept,t} = a_1 + b_1\, margin_{t-1} + c_1\, r^e_{M,t} + u_{1,t}$$
$$r^e_{slope,t} = a_2 + b_2\, margin_{t-1} + c_2\, r^e_{M,t} + u_{2,t}.$$

The security market line intercept and slope are constructed by regressing monthly the cross-section of excess returns of N beta-sorted portfolios on lagged betas estimated over K months. Newey and West (1987) t-statistics are in parenthesis and R^2 are adjusted for degrees of freedom. The sample period is 10/1934-9/1975, 492 monthly observations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
a_1	-1.211	-0.953	-1.102	-1.047	-1.009	-0.904	0.474
	(-1.62)	(-1.35)	(-1.37)	(-1.48)	(-1.32)	(-1.23)	(2.17)
a_2	1.360	3.512	1.266	1.200	1.208	1.020	-0.445
	(1.78)	(3.03)	(1.56)	(1.64)	(1.53)	(1.32)	(-1.97)
b_1	0.028	0.025	0.026	0.025	0.025	0.023	0.164
	(2.44)	(2.25)	(2.13)	(2.31)	(2.14)	(2.03)	(2.97)
b_2	-0.030	-0.054	-0.028	-0.026	-0.027	-0.024	-0.169
	(-2.55)	(-3.14)	(-2.27)	(-2.40)	(-2.28)	(-2.07)	(-2.98)
c_1	0.110		0.074	0.153	0.150	0.114	0.101
	(1.17)		(0.79)	(1.66)	(1.60)	(1.24)	(1.09)
c_2	0.916		0.951	0.875	0.872	0.915	0.925
	(9.14)		(9.31)	(8.91)	(8.76)	(9.13)	(9.26)
$R^2_{intercept}$	0.022	0.007	0.011	0.039	0.033	0.019	0.037
R^2_{slope}	0.534	0.018	0.522	0.543	0.510	0.522	0.540
K	36	36	36	36	24	48	36
N	20	20	10	40	20	20	20

line. They find that the lagged level of the TED spread has a negative effect on the returns to their betting against beta strategy returns. A high TED spread is usually considered to be an indication of tighter funding constraints which, according to the theory, should result in a flatter security market line and higher returns to the strategy. Hence, this result seems to be in contrast with their model predictions. They explain the result as the lagged TED spread possibly being a proxy for the change in credit conditions, in which case the negative correlation would be expected. However, no evidence is provided to support the conjecture that the TED spread level forecasts changes in credit conditions. As argued above, the margin requirement is a better measure of margin constraints faced by investors than the TED spread, and hence it is not surprising that my results are more in line with the predictions of the theoretical model.

These results also have direct consequences for the empirical testing of the CAPM. As binding margin constraints make the security beta–expected return relation flatter, they will also help to reject the CAPM hypothesis that the security market line has a zero intercept and a slope equal to market return. If we fix the market excess return at its sample average of 0.72 and use the coefficients in the first column of Table 3, we find that an initial margin of 41% would result in the security market line intercept to be equal to zero. In the same exercise, an initial margin of 44% would make the slope equal to the market excess return. This simple calculation indicates that at relatively low levels of initial margin the CAPM might not be rejected empirically. This is also evident in the upper left panel of Figure 1 that plots the relation between beta and average return for periods of low margin requirement. For most part of the sample period, the margin requirement has been above these low levels required to match the CAPM predictions and the CAPM is rejected using full sample period data.

Columns (2)-(7) of of Table 3 provide robustness checks of the key result presented in column (1). First, in column (2), I repeat the regressions excluding the market excess return from the right-hand-side. The effect of margin requirement on the security market line intercept is unchanged by this exclusion and the coefficient of margin in the slope regression becomes larger and more significant. These findings show that the results reported in column (1) are in no way driven by correlation between the market returns and the initial margin requirements. Second, in columns (3) and (4), I repeat the basic result but using 10 and 40 beta-sorted portfolios instead of 20 as in column (1). All the coefficients are practically identical to those reported in column (1). Third, in columns (5) and (6) present the results using a 24-month and 48-month windows to estimate portfolio betas. Again, the results are nearly identical to those using a 36-month window.

Finally, column (7) of Table 3 reproduces the result presented in column (1) but replacing the actual initial margin with a factor mimicking portfolio. To avoid a mechanical relation between the factor mimicking portfolio and the test assets, I construct the mimicking portfolio using 41 Fama and French industry portfolios. These are those of the 49 industry portfolios for which complete return data exists for the period 10/1934-9/1975.[10] I construct the factor mimicking

[10]Due to this data requirement I exclude the following industries: soda, healthcare, rubber and plastic products,

portfolio by maximizing the portfolio's correlation with the initial margin requirement subject to constraints that the portfolio has a zero cost and a zero beta. The correlation between the resulting mimicking portfolio and the actual margin requirement is 0.25. The results presented in column (7) of Table 3 show that the conclusion that margin constraints affect the security market line is robust also to using a factor mimicking portfolio in the place of the margin requirement. Overall, the results reported in Table 3 provide very robust support for the theoretical model of Frazzini and Pedersen (2013): higher initial margin requirements increases the intercept and decreases the slope of the security market line.[11]

To benchmark these results with those in Frazzini and Pedersen (2013), I next include a measure of credit spread as an explanatory variable. Ideally, I would control for the TED spread as Frazzini and Pedersen do but the data for the Eurodollar rates only begins in 1984, ten years after the Federal Reserve ended the active management of the initial margin requirement. Hence, I use the yield spread between AAA and BAA rated corporate bonds as a measure of credit spread.[12] Two important findings arise from the results presented in Table 4. First, the credit spread itself does not have a significant effect on the security market line as coefficients d_1 and d_2 are statistically indistinguishable from zero. Second, the coefficients of the margin requirement (b_1 and b_2) are very close to those reported in Table 3. Hence, it can be concluded that it is the constraint on maximum leverage–rather than the cost of such leverage–that affects the security market line. This empirical conclusion is in perfect harmony with the theoretical prediction summarized in Equation (1).

fabricated products, defense, precious metals, computer software, and business supplies.

[11]The results are also robust for the choice of the sample period. If the sample period is extended from 1975:09 to 2012:12 the parameter estimates of interest are nearly identical to those reported in the first column of Table 3. In the longer sample, b_1 equals 0.024 with a t-statistic of 2.20 and b_2 equals -0.026 with a t-statistic of 2.35. Studying this longer sample may, however, is less meaningful as the initial margin requirement has stayed at 50% since 1974:01.

[12]Between 1984 and 2012, the correlation between the credit spread and the TED spread is 0.44.

Table 4: Controlling for credit spread.
This table presents the results of regressing monthly security market line intercept and slope on the lagged initial margin requirement, the contemporaneous market excess return, and lagged credit spread:

$$\begin{aligned} r^e_{intercept,t} &= a_1 + b_1\, margin_{t-1} + c_1\, r^e_{M,t} + d_1\, spread_{t-1} + u_{1,t} \\ r^e_{slope,t} &= a_2 + b_2\, margin_{t-1} + c_2\, r^e_{M,t} + d_2\, spread_{t-1} + u_{2,t}. \end{aligned}$$

The security market line intercept and slope are constructed by regressing monthly the cross-section of excess returns of 20 beta-sorted portfolios on lagged estimated portfolio betas. Newey and West (1987) t-statistics are in parenthesis and R^2 are adjusted for degrees of freedom. The sample period is 10/1934-9/1975, 492 monthly observations.

	(1)	(2)
a_1	0.639	-2.349
	(1.52)	(-1.90)
a_2	-0.733	2.157
	(-1.68)	(1.66)
b_1		0.038
		(2.69)
b_2		-0.037
		(-2.51)
c_1	0.103	0.109
	(1.05)	(1.19)
c_2	0.923	0.916
	(8.81)	(9.13)
d_1	-0.157	0.493
	(-0.48)	(1.15)
d_2	0.284	-0.345
	(0.83)	(-0.77)
$R^2_{intercept}$	0.010	0.023
R^2_{slope}	0.528	0.533

4.2 Robustness checks

Table 5: Controlling for Fama-French factors and inflation.
This table presents the results of regressing monthly security market line intercept and slope on the lagged initial margin requirement, the contemporaneous market excess return, SMB and HML factors, and lagged inflation:

$$\begin{aligned} r^e_{intercept,t} &= a_1 + b_1\, margin_{t-1} + c_1\, r^e_{M,t} \\ &\quad + d_1\, SMB_t + e_1\, HML_t + f_1\, inflation_{t-1} + u_{1,t} \\ r^e_{slope,t} &= a_2 + b_2\, margin_{t-1} + c_2\, r^e_{M,t} \\ &\quad + d_2\, SMB_t + e_2\, HML_t + f_2\, inflation_{t-1} + u_{2,t}. \end{aligned}$$

The security market line intercept and slope are constructed by regressing monthly the cross-section of excess returns of 20 beta-sorted portfolios on lagged estimated portfolio betas. Newey and West (1987) t-statistics are in parenthesis and R^2 are adjusted for degrees of freedom. The sample period is 10/1934-9/1975, 492 monthly observations.

	(1)	(2)	(3)
a_1	-0.779	-1.286	-0.891
	(-1.18)	(-1.69)	(-1.32)
a_2	0.906	1.428	1.014
	(1.35)	(1.82)	(1.50)
b_1	0.022	0.029	0.024
	(2.14)	(2.43)	(2.23)
b_2	-0.024	-0.031	-0.026
	(-2.25)	(-2.52)	(-2.36)
c_1	0.285	0.109	0.284
	(3.64)	(1.16)	(3.70)
c_2	0.731	0.917	0.731
	(8.60)	(9.12)	(8.59)
d_1	-0.506		-0.512
	(-4.62)		(-4.63)
d_2	0.539		0.545
	(4.98)		(4.89)
e_1	-0.268		-0.264
	(-2.92)		(-2.94)
e_2	0.279		0.274
	(3.04)		(3.02)
f_1		-0.583	-0.844
		(-0.58)	(-0.90)
f_2		0.527	0.810
		(0.51)	(0.87)
$R^2_{intercept}$	0.183	0.020	0.183
R^2_{slope}	0.616	0.533	0.616

Tables 5 and 6 provide additional robustness checks by controlling for standard risk factors and by using alternative sets of test assets. The result of an association between the initial margin level and the security market line shape could be driven by an omitted variable. This would arise if the margin level is correlated with some factor known to affect the intercept and the slope of the security market line but is not included in the regression. To check that the results presented in Table 3 are robust to other risk factors, the first column of Table 5 presents the results of regressing the intercept and the slope on the margin, the market excess return, and the size and value factors of Fama and French (1993). SMB and HML significantly affect both the intercept and the slope of the security market line but their inclusion in the model does not affect the inference regarding the impact of the margin constraints: the initial margin still has a significant positive effect on the intercept and a significant negative effect on the slope.

Another candidate for omitted variable is the level of inflation as it is shown to affect the beta–expected return relation by Cohen, Polk, and Vuolteenaho (2005). I follow Campbell and Vuolteenaho (2004) and Cohen, Polk, and Vuolteenaho (2005) and construct the time series of inflation as an exponentially smoothed average of log-changes in the U.S. producer price index. As Cohen, Polk, and Vuolteenaho (2005), I use decay parameter of 0.9806 to smooth the data. The second column of Table 5 shows that the inclusion of lagged inflation has no effect on the coefficients of the initial margin in either the intercept or the slope equation. Finally, the third column of Table 5 shows that the main results are also robust for including the Fama and French (1993) factors and lagged inflation as controls at the same time.[13]

In Table 6, I check that the results are also robust for using alternative test assets. In the first column, the test assets comprise of the 20 beta-sorted portfolios and ten size-sorted portfolios. In the second column, I use the 20 beta-sorted and ten book-to-market-sorted portfolios, and in the third column the 20 beta-sorted, ten size-sorted, and ten book-to-market-sorted portfolios together. In all of these specifications, the coefficient of interest (i.e. b_1 and b_2) are very close to the values reported in the first column of Table 3 for the 20 beta-sorted portfolios. These coefficients are also statistically significant in all specification. In the last column of Table 6, I use a totally different set of test assets: 41 industry portfolios. These, again, are those of the 49 Fama and French industry portfolios for which full return history is available for the period 10/1934-9/1975. The main result of the paper also holds for this alternative set of test asset: the initial margin level has a significant positive effect on the security market line intercept and a significantly negative effect on the slope.

Potentially, the results presented above—that the initial margin affects the security market line—could be driven by a common factor driving both the initial margin levels and the shape of the security market line. More specifically, the margin requirement could reflect general market conditions that also affect the security market line. The most obvious candidate for such common

[13] An additional candidate control variable would be the aggregate disagreement by Hong and Sraer (2012). However, the calculation of the aggregate disagreement uses analyst forecast data from I/B/E/S which is not available for the period of time when there was variation in the initial margin requirement. Hence, including the disagreement measure as a control in Table 5 is not feasible.

Table 6: Alternative test assets.
This table presents the results of regressing monthly security market line intercept and slope on the lagged initial margin requirement and the contemporaneous market excess return:

$$r^e_{intercept,t} = a_1 + b_1\, margin_{t-1} + c_1\, r^e_{M,t} + u_{1,t}$$
$$r^e_{slope,t} = a_2 + b_2\, margin_{t-1} + c_2\, r^e_{M,t} + u_{2,t}.$$

The security market line intercept and slope are constructed by regressing monthly the cross-section of test asset excess returns on lagged estimated portfolio betas. The test portfolios in each column are the following. (1): 20 beta-sorted and 10 ME-sorted portfolios, (2): 20 beta-sorted and 10 BE/ME-sorted portfolios, (3): 20 beta-sorted, 10 ME-sorted, and 10 BE/ME-sorted portfolios, (4): 41 Fama-French industry portfolios (the 49 industry portfolios excluding soda, healthcare, rubber and plastic products, fabricated products, defense, precious metals, computer software, and business supplies for which data does not exist for the full sample period). Newey and West (1987) t-statistics are in parenthesis and R^2 are adjusted for degrees of freedom. The sample period is 10/1934-9/1975, 492 monthly observations.

	(1)	(2)	(3)	(4)
a_1	-1.445	-1.057	-1.248	-1.354
	(-1.59)	(-1.33)	(-1.41)	(-2.59)
a_2	1.573	1.198	1.384	1.392
	(1.74)	(1.47)	(1.55)	(2.57)
b_1	0.029	0.025	0.026	0.030
	(2.15)	(2.11)	(2.00)	(3.37)
b_2	-0.030	-0.027	-0.028	-0.029
	(-2.25)	(-2.20)	(-2.09)	(-3.20)
c_1	0.168	0.125	0.164	0.374
	(1.68)	(1.34)	(1.68)	(5.53)
c_2	0.856	0.889	0.852	0.649
	(8.24)	(8.95)	(8.29)	(10.04)
$R^2_{intercept}$	0.035	0.024	0.034	0.223
R^2_{slope}	0.460	0.519	0.465	0.473

Table 7: Decomposing the initial margin.
This table presents the results of regressing monthly security market line intercept and slope on two components of the lagged initial margin requirement and the contemporaneous market excess return:

$$r^e_{intercept,t} = a_1 + b_1^{res}\, margin^{res}_{t-1} + b_1^{fit}\, margin^{fit}_{t-1} + c_1\, r^e_{M,t} + u_{1,t}$$
$$r^e_{slope,t} = a_2 + b_2^{res}\, margin^{res}_{t-1} + b_2^{fit}\, margin^{fit}_{t-1} + c_2\, r^e_{M,t} + u_{2,t}.$$

The initial margin is decomposed into two components by regressing it on measures of market conditions (contemporaneous and lagged market return, standard deviation of daily market returns, and skewness of daily market returns). The fitted values of this regression, $margin^{fit}$, represent the part of margin requirement that is driven by the market conditions whereas the residual, $margin^{res}$, is the part orthogonal to the market conditions. The security market line intercept and slope are constructed by regressing monthly the cross-section of excess returns of 20 beta-sorted portfolios on lagged estimated portfolio betas. Newey and West (1987) t-statistics are in parenthesis and R^2 are adjusted for degrees of freedom. The sample period is 10/1934-9/1975, 492 monthly observations.

	(1)	(2)	(3)
a_1	0.479	0.045	0.005
	(2.37)	(0.02)	(0.00)
a_2	-0.453	0.636	0.676
	(-2.15)	(0.27)	(0.28)
b_1^{res}	0.030		0.030
	(2.66)		(2.73)
b_2^{res}	-0.031		-0.031
	(-2.72)		(-2.72)
b_1^{fit}		0.007	0.008
		(0.18)	(0.20)
b_2^{fit}		-0.018	-0.018
		(-0.45)	(-0.47)
c_1	0.108	0.103	0.109
	(1.18)	(1.11)	(1.15)
c_2	0.918	0.922	0.916
	(9.14)	(9.06)	(9.07)
$R^2_{intercept}$	0.023	0.010	0.021
R^2_{slope}	0.532	0.526	0.531

factor, the contemporaneous market return, is controlled for in all the regressions presented above. However, it is possible that some other measures of market condition, contemporaneous or lagged, could affect the variables of interest. To confirm that this is not the case, I decompose the initial margin requirement into two components: one reflecting market conditions and a residual component that is independent of market conditions. To perform the decomposition, I regress the margin requirement on contemporaneous and lagged market return, standard deviation of daily market returns, and skewness of daily market returns.[14] The component of initial margin that reflects the market conditions is then simply the fitted values of this regression, $margin^{fit}$. The residuals of this regression, $margin^{res}$, represent the part of the margin requirement that is independent of the prevailing and past market conditions.

Table 7 presents the results of regressing the security market line intercept and slope on the two components of the initial margin and the contemporaneous market return. The results in this table confirm that the results presented above are not driven by market conditions affecting the initial margin and the security market line simultaneously. The coefficients of $margin^{res}$, i.e. the part of margin requirement that is orthogonal to market conditions, have the predicted sign and are statistically very significant. Conversely, the coefficients of $margin^{fit}$, the part of are margin requirement that is correlated with market conditions, are not statistically significantly different from zero.

As a final robustness check, I replace $margin_{t-1}$ in Equation (3) with different monotonically increasing functions of the initial margin. Table 8 reports the results using four different functional forms of the initial margin: squared, exponential, logarithmic, and negative reciprocal. In all cases, the margin-based explanatory variables are standardized for ease of comparison. The results based on these different specifications provide further evidence of the robustness of the key results: with all four functional forms, the margin requirement has a highly significant negative impact on the security market line slope and positive effect on the intercept. Probably the most interesting of the four functional forms is $-1/margin$ as it can be interpreted as the negative of the maximum exposure and investor can achieve when purchasing stock.

[14] I use three lags of each of the explanatory variables. However, the results are not sensitive to the choice of the lag length.

Table 8: Alternative functional forms.
This table presents the results of regressing monthly security market line intercept and slope on various functions of the lagged initial margin requirement and the contemporaneous market excess return:

$$r^e_{intercept,t} = a_1 + b_1\, f(margin_{t-1}) + c_1\, r^e_{M,t} + u_{1,t}$$
$$r^e_{slope,t} = a_2 + b_2\, f(margin_{t-1}) + c_2\, r^e_{M,t} + u_{2,t}.$$

The security market line intercept and slope are constructed by regressing monthly the cross-section of excess returns of 20 beta-sorted portfolios on lagged estimated portfolio betas. Newey and West (1987) t-statistics are in parenthesis and R^2 are adjusted for degrees of freedom. The sample period is 10/1934-9/1975, 492 monthly observations.

$f(margin)$	(1) $margin^2$	(2) $\exp(margin)$	(3) $\ln(margin)$	(4) $-1/margin$
a_1	0.481	0.481	0.481	0.481
	(2.22)	(2.22)	(2.19)	(2.19)
a_2	-0.452	-0.452	-0.452	-0.452
	(-2.02)	(-2.02)	(-2.02)	(-2.02)
b_1	0.421	0.427	0.441	0.449
	(2.52)	(2.53)	(2.45)	(2.46)
b_2	-0.451	-0.457	-0.472	-0.480
	(-2.61)	(-2.62)	(-2.59)	(-2.62)
c_1	0.110	0.110	0.110	0.109
	(1.10)	(1.11)	(1.10)	(1.10)
c_2	0.916	0.916	0.916	0.916
	(8.61)	(8.61)	(8.63)	(8.64)
$R^2_{intercept}$	0.021	0.021	0.022	0.023
R^2_{slope}	0.533	0.533	0.534	0.534

4.3 Margin requirement and betting against beta returns

Last, I examine the relation between the initial margin requirement and the betting against beta (BAB) factor.[15] It is interesting to do so as this factor is the center of attention in the empirical analyses of Frazzini and Pedersen (2013). The BAB factor is a zero-beta portfolio that goes long the lowest beta-decile of stocks and short the highest beta-decile. The positions are scaled by the reciprocal of ex ante betas to achieve beta neutrality. This portfolio will have the higher returns the flatter the relation between betas and realized returns is. Hence, it is not surprising that the returns of the BAB factor are positively (0.68) correlated with the security market line intercept and negatively (-0.51) with the slope defined in Equation (1). If tighter funding constraints result in a flatter security market line, the BAB returns should be positively related to the initial margin requirement.

Table 9: BAB results.
This table presents the results of regressing Frazzini and Pedersen (2013) betting against beta returns on the market excess return and the initial margin:

$$r^e_{BAB,t} = a + b\,margin_{t-1} + c\,r^e_{M,t} + u_{1,t}$$

Newey and West (1987) t-statistics are in parenthesis and R^2 are adjusted for degrees of freedom. The sample period is 10/1934-9/1975, 492 monthly observations.

	(1)	(2)	(3)	(4)
a	-0.318	-0.294	0.479	0.489
	(-0.73)	(-0.63)	(4.15)	(4.05)
b	0.013	0.013	0.115	0.115
	(1.91)	(1.81)	(2.39)	(2.39)
c		-0.010		-0.014
		(-0.17)		(-0.24)
R^2	0.005	0.003	0.033	0.032

Table 9 reports the results of regressing the BAB returns on the initial margin requirement and the contemporaneous market return. The first two columns of the table show that the BAB returns are positively associated to the level of the minimum initial margin. The coefficients of the margin are positive and statistically significant at a 10% level. The statistical significance of these results is somewhat weaker than those presented above for the security market line intercept and slope portfolios. This is likely due to the fact that the BAB factor only incorporates information contained in the extreme beta-decile portfolios whereas the intercept and slope portfolios contain information from all the beta sorted portfolios. In the third and fourth column of the table, I replace the initial margin with the factor mimicking portfolio introduced above. The BAB returns are positively and statistically significantly dependent on the returns of the factor mimicking portfolio. However, even after controlling for the initial margin and market returns, the BAB

[15]I thank Lasse Pedersen for making the BAB factor data available on his web site.

factor delivers positive alpha.

It is worthwhile to note that these results again differ somewhat from those presented by Frazzini and Pedersen (2013) regarding the relation between the BAB returns and their measure of funding constraints. They use the TED spread as a measure of funding constraints and find it to have a negative effect on the BAB returns: during periods of higher TED spread, and arguably more binding funding constraints, the BAB returns seem to be lower. This result is in contrast with the predictions based on their theoretical model that tighter funding constraints flatten the security market line. My results, however, provide strong support for the model prediction by showing that during higher initial margin requirements the security market line is flatter and the BAB factor returns are higher.

5 Conclusions

In this paper, I study the effect of leverage constraints on the relation between CAPM betas and expected returns. Using exogenous legal variation in the minimum initial margin requirement in the U.S. stock market, I show that during periods of tighter margin constraints the empirical security market line has a lower slope and a higher intercept than at times of looser constraints. These results are robust to using different test assets and portfolio construction rules, controlling for additional factors, and using different functional forms of the margin requirement. Importantly, the security market line is affected by the part of margin requirement that is orthogonal to the prevailing market conditions. All these results provide strong empirical evidence in support of the hypothesis that tighter funding constrains result in a flatter security market line as predicted by Black (1972) and Frazzini and Pedersen (2013). My findings, however, are slightly at odds with some empirical findings of Frazzini and Pedersen (2013) who find a negative correlation between betting against beta returns and the Treasury-over-Eurodollar (TED) spread. As betting against beta is more profitable when the security market line is flatter, this result would indicate that a higher TED spread (typically used to proxy tight funding constraints) results in a steeper security market line, contrary to their theoretical prediction. TED spread, however, is not an optimal measure of exogenous leverage constraints. Using a better measure of leverage constraints, the minimum initial margin requirement set by the Federal Reserve Board, allows for a better identification of the effects of such constraints on the security market line.

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