ASSET PRICING FOUNDATIONS OF INVESTMENT STRATEGIES

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5. FACTOR PRICING WITH FUNDING LIQUIDITY

Road Map

- Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

- Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

"*We should be getting an incremental return for that illiquidity – and we call that our illiquidity premium –of at least 300 basis points annually on average over what we are expecting in publicly traded stocks*"

– Jane Mendillo, CEO of Harvard Management

In Efficiently Inefficient, Lasse H. Pedersen

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

Measuring trading costs

The central measure is the "effective cost", which is the difference between the execution price and the market price before you started trading (plus any commissions paid)

- For a buy order: $\mathbf{TC^{€} = P^{execution} - P^{before}}$, where the execution price is the price you paid, on average, for all shares you bought and the price before is the mid-quote (the average of the bid and ask prices) just before you started trading

- For a sell order: $\mathbf{TC^{€} = -(P^{execution} - P^{before})}$

-They are computed as a percentage of the value:

$$\mathbf{TC = TC^{€} / P^{before}}$$

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

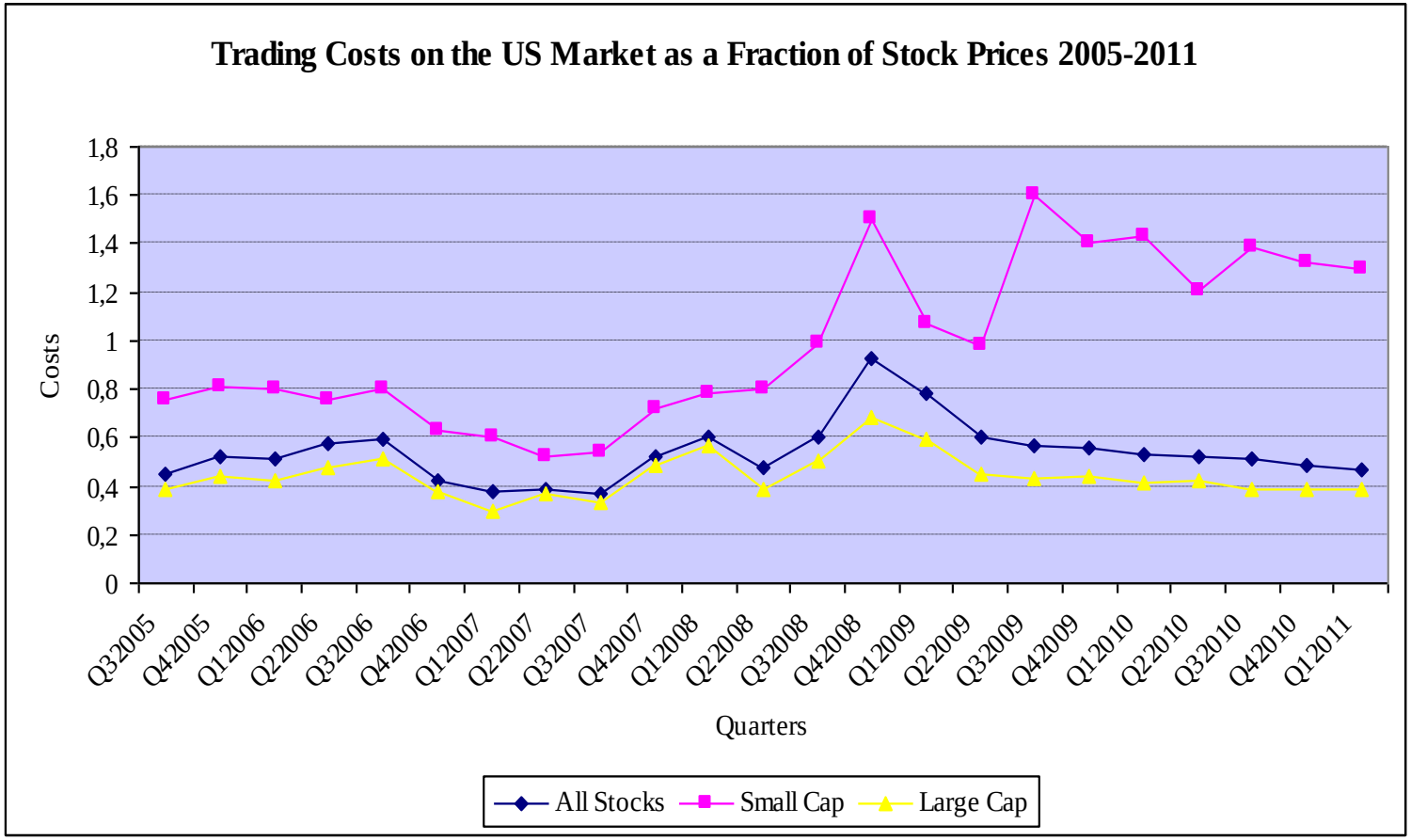
Liquidity risk is the risk that a security will be more illiquid when its owner needs to sell it in the future *in time of an adverse market-wide illiquidity shock*

• The Global Financial Crisis of 2007-2009 illustrates all too dramatically the importance of liquidity and liquidity risk and their effects on securities prices and on the functioning of financial markets

• Figure below shows the variation in trading costs over time as a fraction of the stock price

• At the height of the financial crisis, in the fourth quarter of 2008, average trading costs shot way up reaching 1.5% for small stocks (for some securities, the rise was significantly higher; up to 5%)

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing



Source: Amihud, Mendelson, and Pedersen (2012)

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

► While the Global Financial Crisis of 2007-2009 shows that aggregate (overall) market liquidity can suddenly deteriorate dramatically, the general point is that **market-wide illiquidity is not constant but rather it is time-varying, increasing during financial and economic crisis**

► **Market illiquidity also varies across securities**: the response of individual illiquidity to market-wide illiquidity shocks is different for alternative assets

► It is important to point out the ***flight to liquidity*** we observe after the Global Financial Crisis

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

The empirical evidence makes clear that liquidity is a market-wide phenomena; there is **commonality across assets (co-movement) in liquidity**

► **Hence, these market-wide liquidity shocks may be a source of factor risk** (systematic, non-diversifiable) that should be priced by risk averse investors

► **The transmission of market-wide liquidity shocks to price shocks differ across securities**: they differ in the covariance between returns and market-wide liquidity shocks, and risk averse investors would then require higher expected returns for securities whose returns have greater covariance with market-wide liquidity shocks Acharya and Pedersen (2005), Frazzini and Pedersen (2014)

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

The time-varying behavior of market-wide illiquidity

• Amihud (JFM, 2002) proposes the following measure of illiquidity employing daily data on stock prices and trading volume (***without the need of transaction data, bid-ask spreads, or depth***)

• The daily measure of illiquidity for stock *j* in day *d* is given by,

$$ILLIQ_{j,d} = \frac{\left| R_{j,d} \right|}{DVol_{j,d}}$$

where $\left| R \right|$ is the absolute value of the stock return, and *DVol* is volume in dollars (the product of the number of shares traded in the day by the price at the end of the day)

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

• The intuition is that stock is less liquid if a given trading volume generates a greater move in its price (it can be viewed as a coarse measure of Kyle's lambda coefficient)

• A time series of **market-wide illiquidity** is constructed by the two following steps:

1. For each stock, we average its daily illiquidity measure across all days available in the corresponding month

2. Then, we average all individual stocks values for each month across stocks

$$ILLIQ_{j,t} = \frac{1}{D_{jt}} \sum_{d=1}^{D_{jt}} \left(\frac{|R_{j,d,t}|}{Vol_{j,d,t}} \right) \qquad ILLIQ_{m,t} = \frac{1}{N} \sum_{j=1}^{N} ILLIQ_{j,t}$$

Liquidity Risk: Market-Wide Liquidity Shocks and Asset Pricing

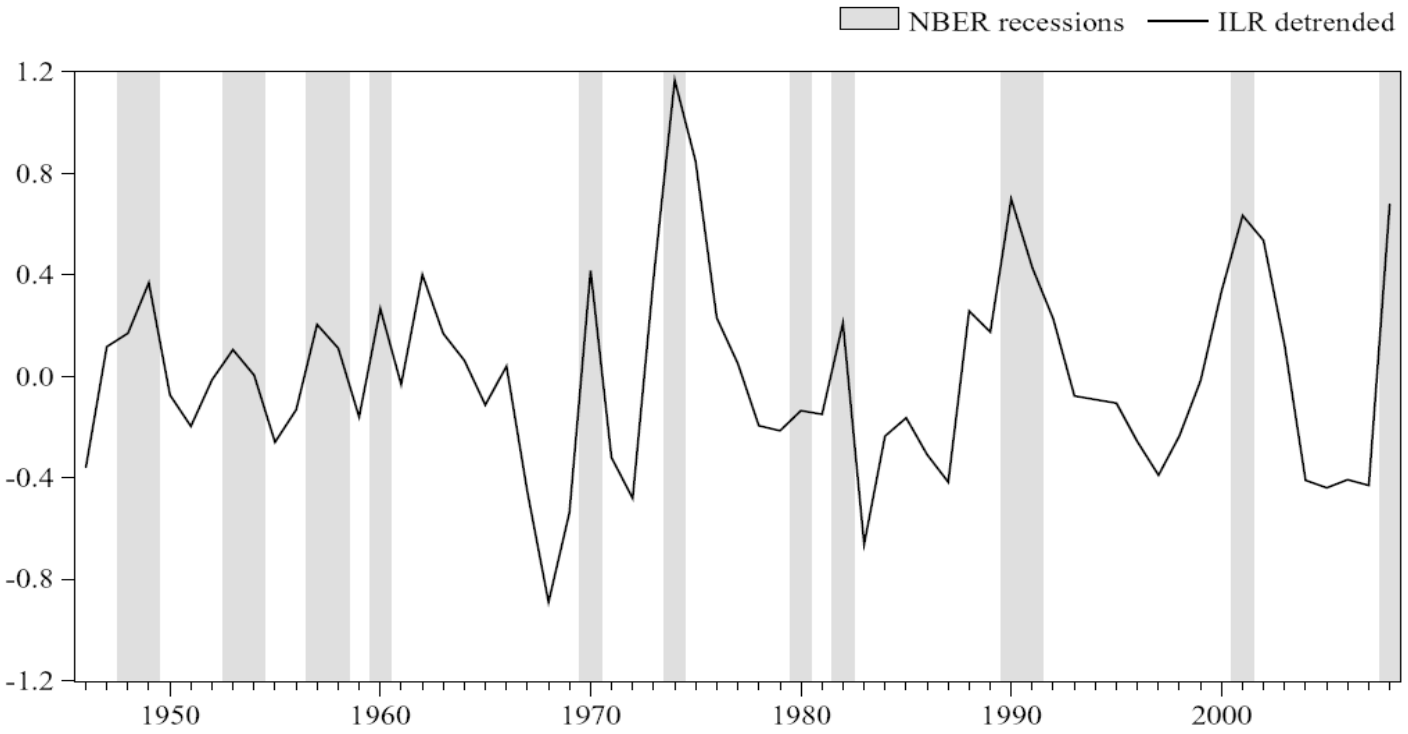


Figure 1. Liquidity and the business cycle. The figure shows time-series plots of the detrended Amihud (2002) illiquidity ratio (*ILR*) for the United States over the period 1947 to 2008. The gray bars indicate the NBER recession periods. *ILR* is an elasticity (price impact) measure of liquidity and reflects how much prices move in response to trading volume. *ILR* is first calculated for each stock for each year. Then the equally weighted cross-sectional average for each year is calculated. A more precise definition is found in equation (2) in the paper. Note that *ILR* reflects illiquidity, so a high value reflects a high price impact of trades (i.e., low liquidity). *ILR* is detrended using a Hodrick–Prescott filter.

Source: Naes, Skjeltorp, and Odegaard (JF 2011)

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

• Every month we estimate the market beta for each stock

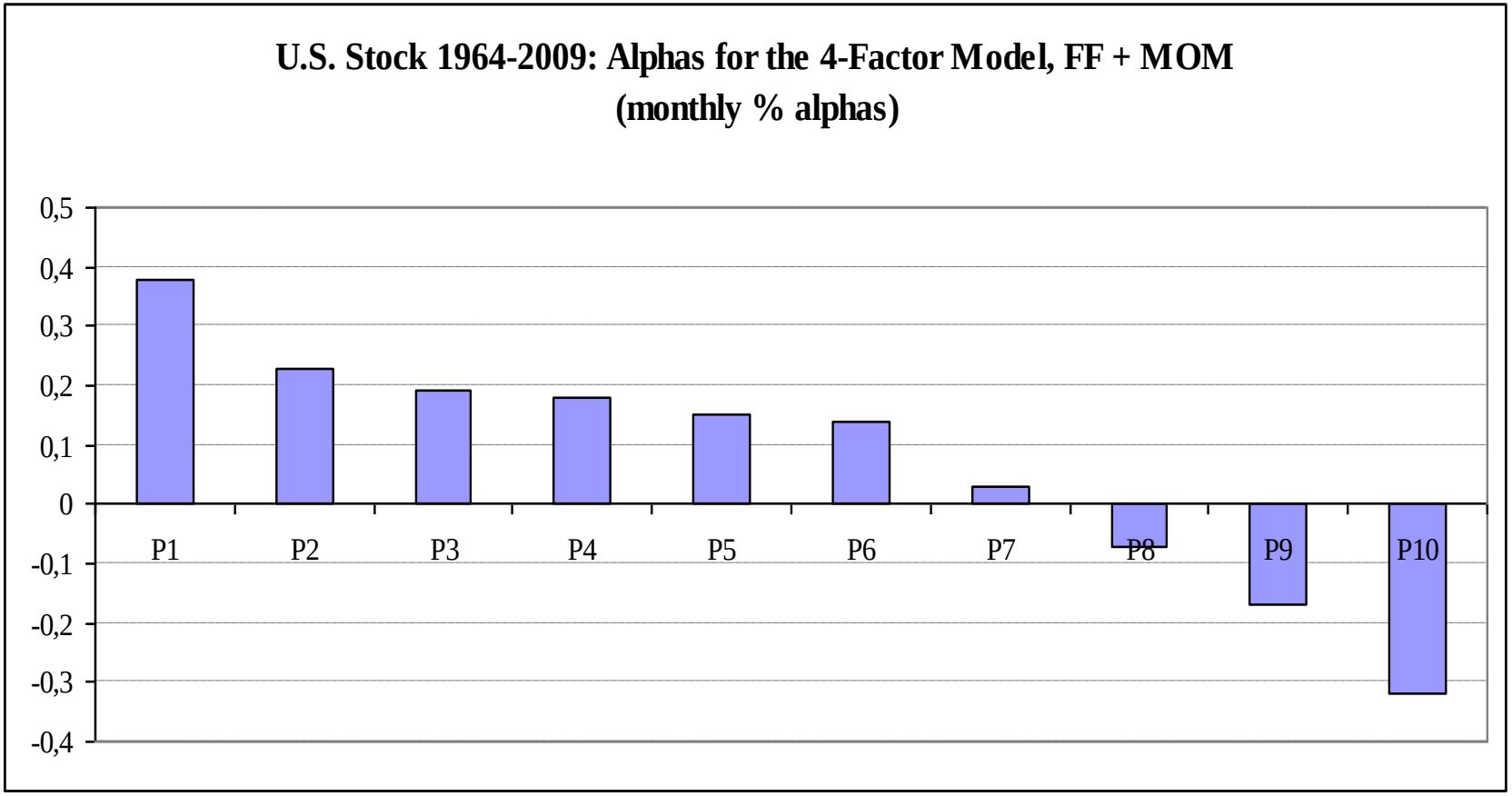
• Then, every month we rank all stocks according to their beta and we form 10 portfolios, where portfolio 1 contains the stocks with the lowest betas, and portfolio 10 the stocks with the highest betas

• We re-estimate the rankings every month, so we make sure that portfolio 1 always has the lowest betas, and portfolio 10 the highest betas

• Then, we estimate the alphas of the 10 portfolios from January 1964 to December 2009

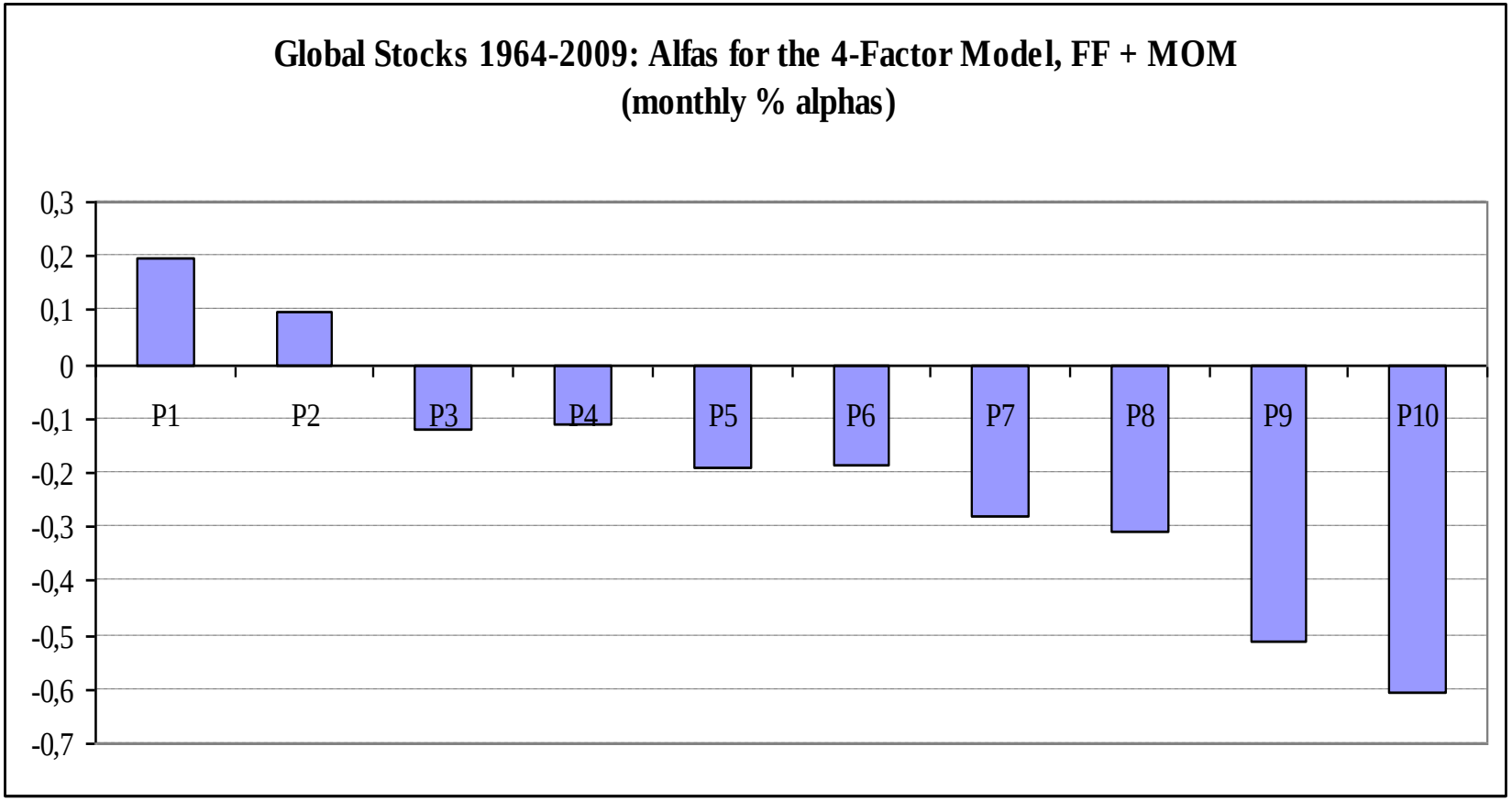
Pedersen and Frazzini, JFE 2014

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

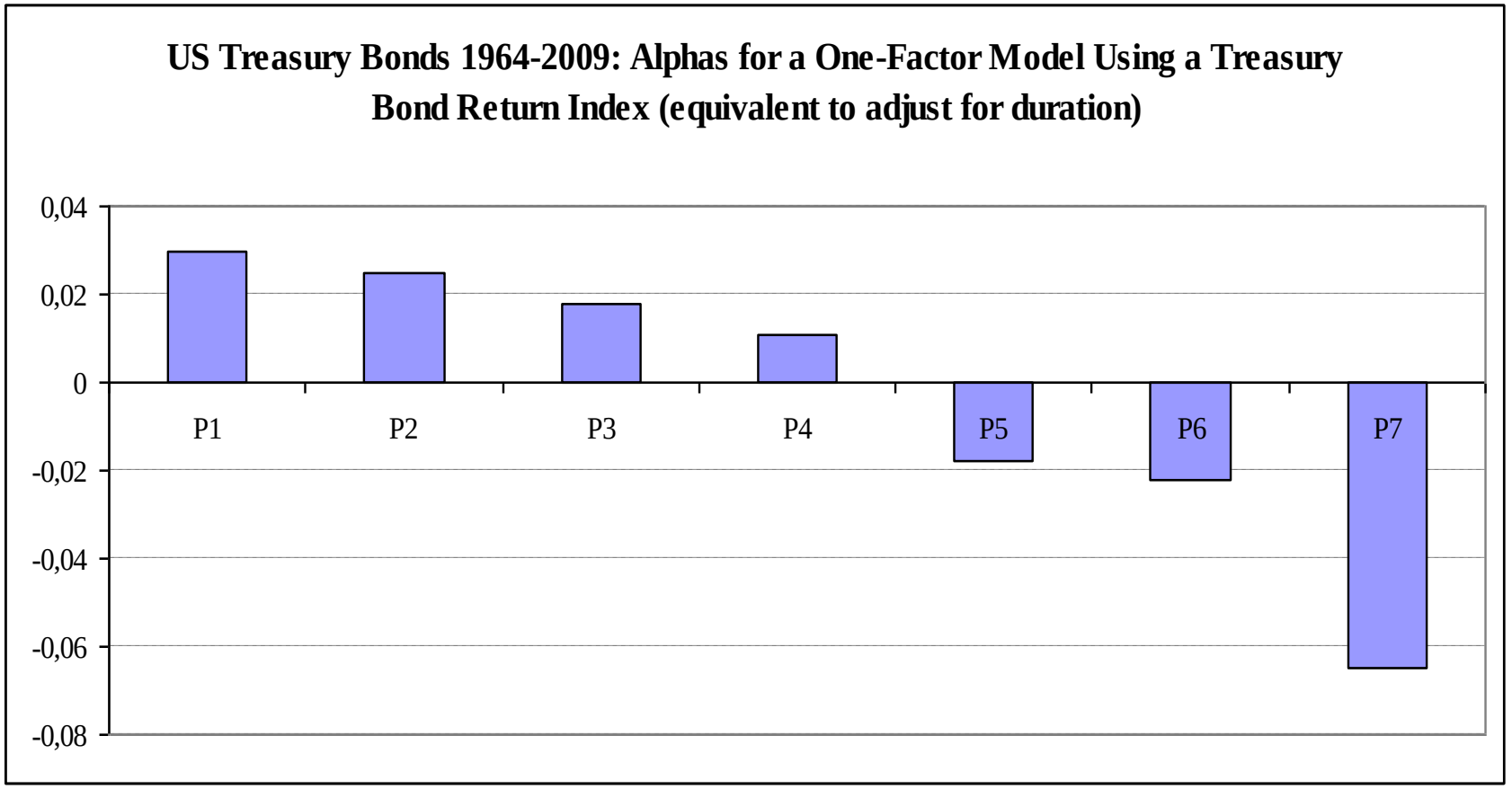


Risk-adjusted returns are higher for low beta stocks than for high beta stocks!!!

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model



Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model



Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

It would be enough if each of you give me 100,000 € to start up a hedge fund!

I'll give you my account number after class, so you can transfer the money

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

• **Market liquidity** is the ease of trading a security; a security is liquid if its trading cost is low (it has a low bid-ask spread with high depth and, therefore, a *small market impact*)

• **Funding liquidity** is the ease access to financing (ample financing with low restrictions: low borrowing and short sales constraints)

• ***Funding costs*** arise when a trader leverages its investments and must borrow money at a higher interest rate than the interest rate she earns in her cash holdings and short sale proceeds

• Furthermore, leverage is associated with **funding liquidity risk**, that is the risk that the trader cannot continue to finance her positions and is forced to liquidate in a fire sale

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

• Funding liquidity *is a property of both securities and the agents that trade*

- A **security** *has a good funding liquidity if it is easy to borrow using the security as collateral*

- A **trader** *(market maker, dealer, or hedge fund) has good funding liquidity if it has ample capital and access to financing with low margin requirements so it can take desirable positions with few constraints*

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

BASIC EXAMPLE (funding a leveraged long position)

• If a trader buys a security for €100, she may be able to borrow €80 with the security as collateral

• The 20% of its value that must be financed with the trader´s own capital is called a **margin requirement** (or "haircut")

• A 20% margin requirement means that a trader can leverage this security 5-to-1 while **a higher market requirement would mean that less leverage is available**

The haircut gives the lender an extra margin of safety in the case the value of the security suddenly drops and you do not want to pay the lender back: the lender can simply sell the security and recover the loan (at least part of the loan)

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

The investment constraint depends on the agent *i*

- Some agents cannot use leverage, which is captured by $m^i = 1$

- Other agents not only may be precluded from using leverage but also must have some of their wealth in cash, $m^i > 1$

For example, someone with $m^i = 1/(1-0.20) = 1.25$ represents an agent who must hold 20% for her wealth in cash (for instance, mutual funds)

- Others may be able to use leverage but may face margin constraints

If an agent faces a margin constraint of 20%, then $m^i = 0.2$

A smaller margin requirement naturally means that the agent can take greater positions (can borrow more)

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

How margin requirements are set

• These margins are set to limit the lender's risk and must be large enough to cover the "worst-case" with a certain confidence

• For a long position, this means that the probability of a drop in the price greater than the margin requirement *m* must be low, say, below 1%

$$Pr\left(-\frac{P_{t+1}-P_t}{P_t} > m\right) = 1\%$$

• The margin requirement is a fraction of the value of the asset, so *m* is between 0% and 100%

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

• Therefore, the amount of money a trader needs to support its position is the margin requirement *m* times the *price* times the *number of shares* the trader buys

• It must have enough capital to fund the sum of all positions:

$$\sum_j m_j \times P_j \times Position\ \ Size_j \leq Equity\ Capital$$

• Failing to meet this requirement has led to spectacular hedge fund collapses and other financial institutions AIG, Lehman Brothers, and Bear Stearns are sad examples of institutions failing this inequality, that is, not being able to fund their positions

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

► Since investors have limited funding and face leverage constraints, they prefer to hold assets with lower margin requirements (assets that use less capital), and the security´s required return increases in its funding requirements:

$$E(R_j) = R_f + \beta_j \lambda_m + \textit{market liquidity compensation} + \textbf{\textit{funding liquidity compensation}}$$

where the funding requirement compensation depends on how tightness is the overall funding liquidity constraint which varies over time, being high during liquidity crisis

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

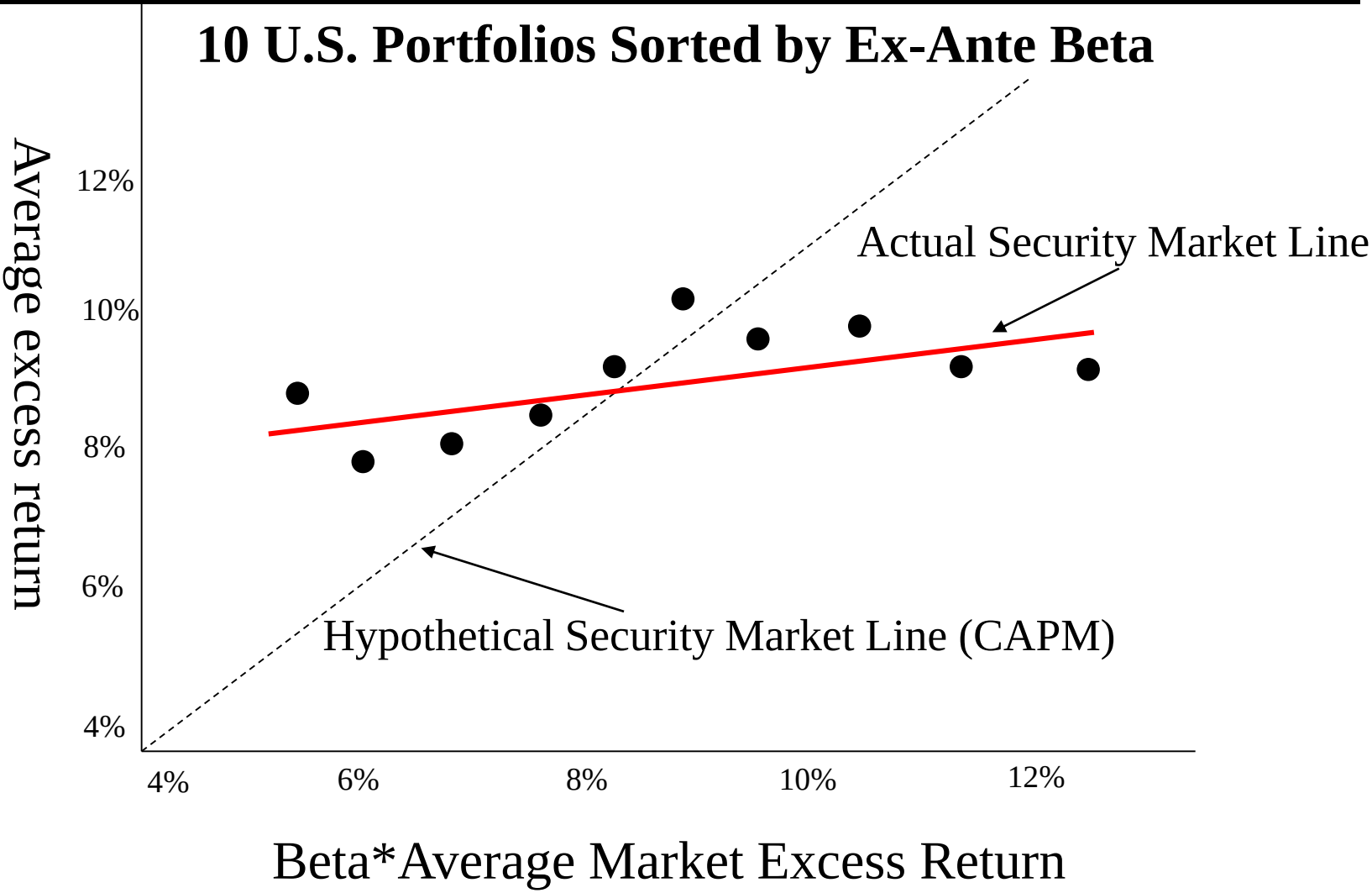
• The classic CAPM says that a security's expected excess return (over the risk-free rate) should be proportional to its beta: if stock A has a beta of 0.70 and stock B has twice the beta of 1.40, then stock B should have twice the excess return on average

• However, the CAPM does not hold empirically as the average risk-adjusted returns on low-beta stocks is almost as high as the average risk-adjusted return of high-beta stocks: The security market line (SML) is too flat empirically as seen in the figure below

Can we exploit the flat security market line? The safe stocks are the ones that have high returns compared to what the CAPM says they should (safe stocks have higher risk-adjusted returns)

The safe stocks have positive alpha and the risk stocks have negative alpha

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model



Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

• However, the idea is not just to buy the safe stocks and short-sell the risky stocks: you want to have a **market-neutral portfolio** (a portfolio with no exposure to the market)

• You want to exploit the differences between low-beta and high-beta stocks through a market neutral position, for which your portfolio has a beta of zero

• Suppose that the low-beta is 0.6677, and the high-beta is 1.4285

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

- With the low- and high-betas of 0.6667 and 1.4285:
- We go long €1.5 (1/0.6667) in stocks of low beta (levered)
- We go short €0.7 (1/1.4285) in stocks of high beta (delevered)
- This portfolio does make money because it exploits the fact that, while safe and risky stocks have similar average returns, the safe stocks have significantly higher Sharpe ratios
- This portfolio exploits the differences in Sharpe ratios by leveraging the safe stocks and deleveraging the risky ones so that both the long and short sides of the portfolio have a beta of 1; beta long position: 1.50*0.667 = 1 **minus** beta short position: 0.7*1.4285 = 1 for a final portfolio beta of 0 (market neutral)

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

- The return of the portfolio with low beta (β_{Lt}) is

$$R_{Lt+1} = \omega'_L R_{\in low\, beta_t}$$

- The return of the portfolio with high beta (β_{Ht}) is

$$R_{Ht+1} = \omega'_H R_{\in high\, beta_t}$$

- where

$$\beta_{Lt} < \beta_{Ht}$$

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

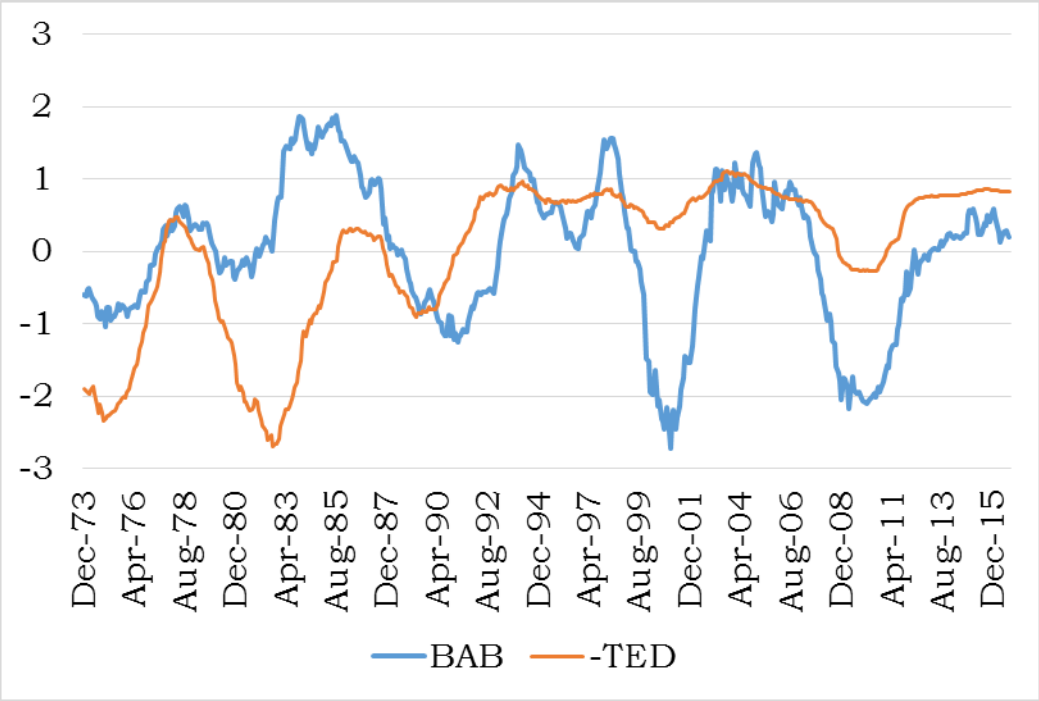
- This portfolio is called a ***betting-against-beta*** **(BAB) factor** whose return is given by

$$R_{t+1}^{BAB} = \frac{1}{\beta_{Lt}}\left(R_{Lt+1} - R_f\right) - \frac{1}{\beta_{Ht}}\left(R_{Ht+1} - R_f\right)$$

By leveraging and deleveraging up, the long and short portfolios are unit beta positions in the low- and high-beta portfolios to end up with a market neutral position

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

3-year BAB cumulative return and 3-year (negative) average rolling TED spread (standardized units)



TED: T-bill - Euro-Dollar; high in periods of financial constraints.

BAB returns tend to be lower in periods of low funding liquidity (high financial constraints)

The BAB returns tend to be lower in periods of high TED spread (low liquidity)

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

BAB (4/1980-5/2016)	Coefficient	*t*-stat
Alpha	0.621% (7.45% annual)	4.04
Market Beta	0.013	0.36
SMB Beta	0.050	0.96
HML Beta	0.595	10.94
MOM Beta	0.259	7.60
Adj R^2	0.273	

$$R_{bab,t} = \alpha_{bab} + \beta_{bab,m}\left(R_{m,t} - R_{f,t}\right) + \beta_{bab,smb} SMB_t + \beta_{bab,hml} HML_t + \beta_{bab,mom} MOM_t + \varepsilon_{bab,t}$$

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

One (important) reason that low-risk investing seems to work is that many investors face **leverage constraints** or are simply afraid of the risks that comes with leverage

• Therefore, investors looking to pick up a higher return might buy risky securities rather than applying leverage to a portfolio of safe securities

• This behavior pushes up the prices of risky stocks –and high prices mean low returns

• This simultaneously lower the demand for safe stocks, lowering their prices and increasing their expected returns

▸ **Borrowing/margin constrains confer an advantage to high-beta stocks for which investors accept lower return**

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

• Hence, a **modified CAPM equilibrium** arises in which the security market line is flatter due to leverage-constrained investors buying the risky stocks while less constrained investors leverage the safer stocks: leverage-constrained investors overweight high-beta stocks as a substitute for leverage

• This the BAB theory of asset pricing or the "margin-CAPM"

• This theory can therefore explain why mutual funds and individual investors (who might be leverage constrained or averse) hold stocks with betas above one on average while Buffet and leveraged buyout (LBO) investors apply leverage to safe stocks on average

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

THE MARGIN-CAPM

Agents $i = 1, \ldots, I$ have initial period wealth W_t^i, and trade securities $j = 1, \ldots, N$ where each asset pays a dividend D_{jt} and has z_j^* shares outstanding

Each time period t, agents choose a portfolio of shares z (an N-vector), investing the rest at the risk-free return to maximize expected CARA utility,

$$Max\ z'\left[E_t\left(P_{jt+1}+D_{jt+1}\right)-\left(1+R_f\right)P_{jt}\right]-\frac{\gamma^i}{2}z'\Omega_t z$$

where Ω_t is the variance-covariance matrix of $P_{jt+1}+D_{jt+1}$, and γ^i is agent i´s relative risk aversion

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

The key point is that agent *i* is subject to the following portfolio constraint:

$$m_t^i \sum_{j=1}^{N} z_j P_{jt} \leq W_t^i$$

where m_t is the margin requirement, so that this constraint requires that some multiple m_t^i of the total euros invested (number of shares times the price) must be less than her wealth

Note that we assume that all securities have the same margin requirement since we will empirically compare stocks

This explains that the margin requirement goes outside the total value of the portfolio

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

We analyze the properties of the competitive equilibrium in which aggregate demand equals total supply,

$$\sum_i z^i = z^*$$

To derive equilibrium, we write the Lagrangian as

$$Max\ L = z'\left[E_t\left(P_{jt+1} + D_{t+1}\right) - \left(1 + R_f\right)P_{jt}\right] - \frac{\gamma^i}{2} z'\Omega_t z - \psi_t^i\left(\sum_{j=1}^{N} z_j P_{jt} - \frac{W_t^i}{m_t^i}\right)$$

where ψ_t^i is the Lagrange multiplier of the portfolio constraint, which is **the required compensation for tying up capital (the tightness of funding constraint)**

The first order condition for agent *i* is

$$0 = E_t\left(P_{jt+1} + D_{jt+1}\right) - \left(1 + R_f\right)P_{jt} - \gamma^i \Omega_t z^i - \psi_t^i P_{jt}$$

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

Solving for the portfolio choice,

$$z^i = \frac{1}{\gamma^i}\Omega_t^{-1}\left[E_t\left(P_{jt+1}+D_{jt+1}\right)-\left(1+R_f+\psi_t^i\right)P_{jt}\right]$$

The equilibrium condition now follows from summing over these positions,

$$z^* = \frac{1}{\gamma}\Omega_t^{-1}\left[E_t\left(P_{jt+1}+D_{jt+1}\right)-\left(1+R_f+\psi_t\right)P_{jt}\right]$$

where the aggregate risk aversion γ is defined by $\frac{1}{\gamma}=\sum_i \frac{1}{\gamma^i}$

and

$$\psi_t = \sum_i \frac{\gamma}{\gamma^i}\psi_t^i$$

is the weighted average Lagrange multiplier measuring the tightness of funding constraint

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

The equilibrium price can then be computed

$$P_{jt} = \frac{E_t\left(P_{jt+1} + D_{jt+1}\right) - \gamma \Omega_t z^*}{1 + R_f + \psi_t}$$

Translating this into the expected return specification, we get the ***margin-CAPM***

$$E_t\left(R_{jt+1}\right) = R_f + \psi_t + \beta_{jt}\lambda_t$$

where the market risk premium is

$$\lambda_t = E_t\left(R_{mt+1}\right) - R_f - \psi_t$$

Therefore,

$$E_t\left(R_{jt+1}\right) - R_f = \psi_t\left(1 - \beta_{jt}\right) + \beta_{jt}\left[E_t\left(R_{mt+1}\right) - R_f\right]$$

$$\Rightarrow \alpha_{jt} = \psi_t\left(1 - \beta_{jt}\right)$$

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

► The margin-CAPM of equation shows explicitly how the risk premium of any security is affected by the tightness of agents´ portfolio constraints, as measured by the average Lagrange multiplier: securities with betas lower than 1 will apparently have positive CAPM alphas (and securities with betas higher than 1, negative alphas)

► **Tighter portfolio constraints** (larger ψ_t) **flatten the CAPM equation by increasing the intercept and decreasing the slope**

► Note that whereas the classic CAPM implies that the intercept is the risk-free rate, in the margin-CAPM the intercept is increased by the weighted average of the agents´ Lagrange multiplier

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

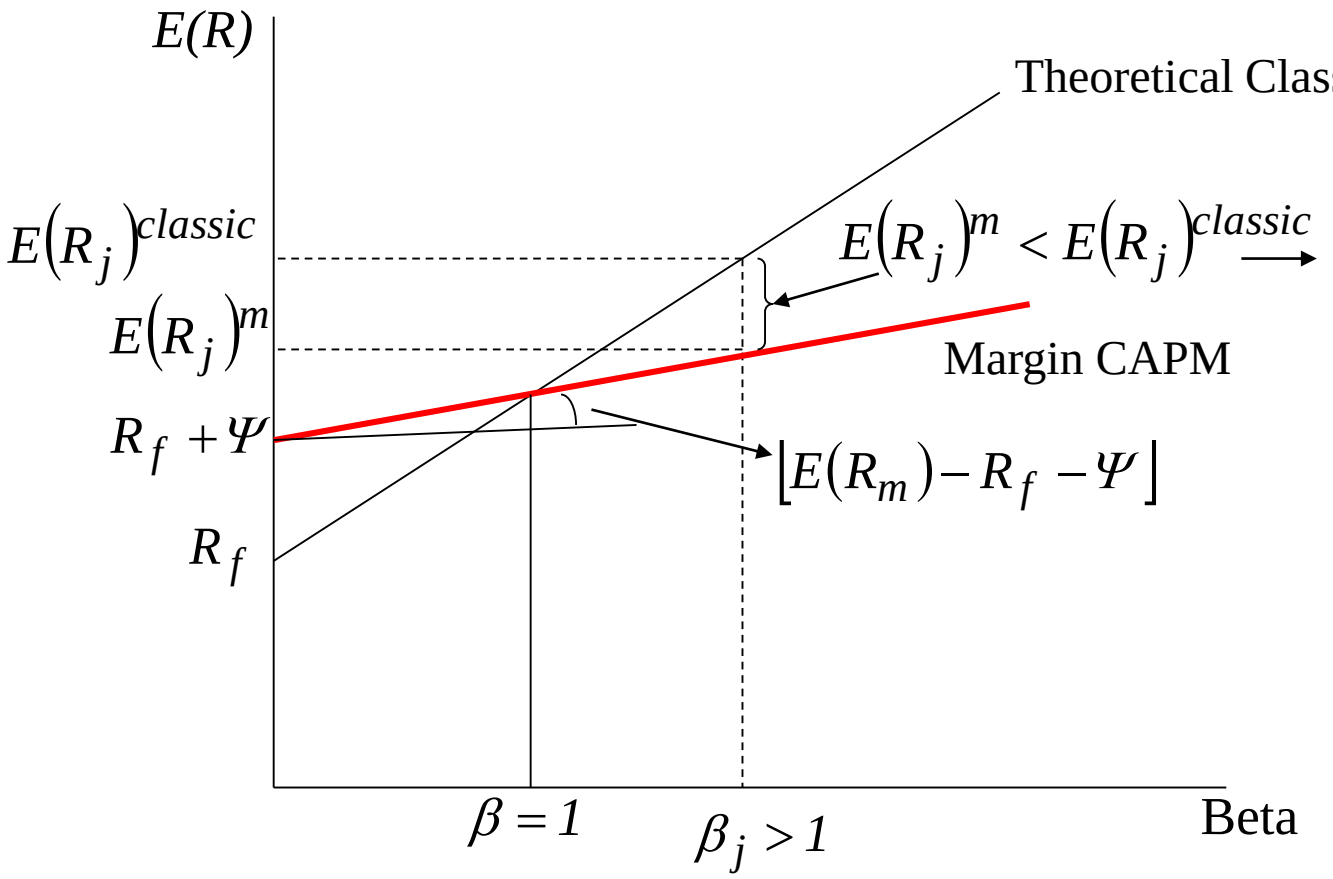
Black (1972) proposed the well known zero-beta CAPM which is a generalization of the traditional CAPM with restricted borrowing

$$E_t\left(R_{jt+1}\right)=E_t\left(R_{Zt+1}\right)+\beta_{jt}\left[E_t\left(R_{mt+1}\right)-E_t\left(R_{Zt+1}\right)\right]$$

where Z is a portfolio with zero-covariance with respect to the market portfolio (it has zero covariance with the market but positive volatility)

The margin-CAPM explains exactly the meaning of the zero-beta portfolio

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model



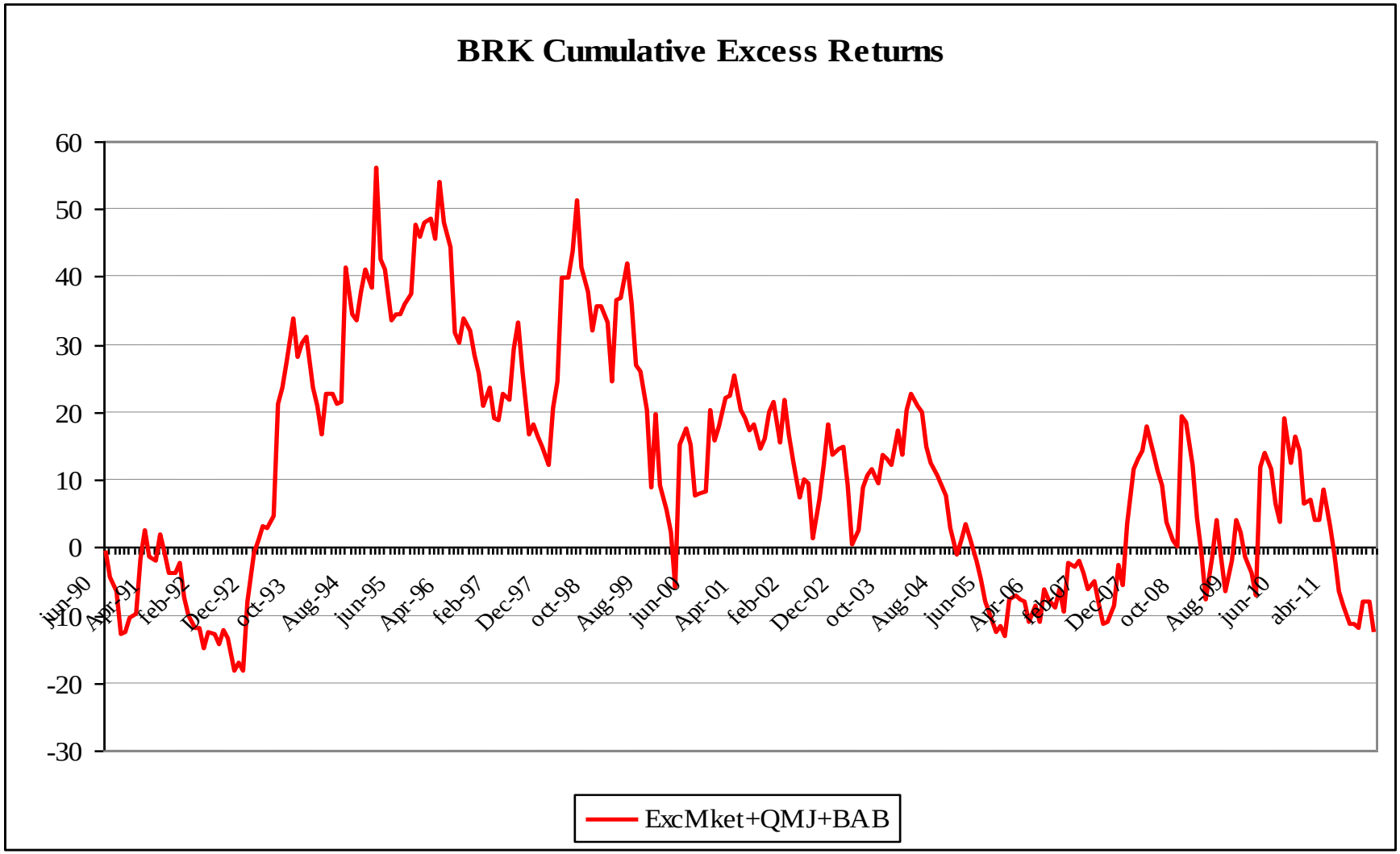
Explaining the low-beta anomaly

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

BRK (4/1980-5/2016)	Coefficient	*t*-stat
Alpha	0.261%	0.89
Market Beta	0.859	11.85
BAB Beta	0.344	4.47
QMJ Beta	0.497	3.92
Adj R^2	0.263	

The BRK alpha goes from 6.68% per year (not statistically significant) with just the market and QMJ to a 3.13% per year adding the BAB factor

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model



High quality and low risk factors playing a role in Buffet's BRK

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

The literature offers different views on the underlying economic drivers of the low-risk (beta) effect. The debate is whether:

a) The low-risk effect is driven by leverage constraints and risk should be measured using systematic risk

b) The low-risk effect is driven by behavioral biases leading to a preference for lottery-like returns, and risk should be measured using idiosyncratic risk

The most powerful way to credibly distinguish these theories is to construct a new factor that captures one theory while at the same time being relatively unrelated to capturing the alternative theory

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

To accomplish this, Asness, Frazzini, Gormsen, and Pedersen (2017) decompose BAB into two factors:

a) Betting against correlation (BAC)*: it goes long stocks that have low correlation to the market and shorts those with high correlation, while seeking to match the volatility of the stocks that are bought and sold*

b) Betting against volatility (BAV)*: it goes long and short based on volatility, while seeking to match correlation*

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

The decomposition of BAB creates a component that is relatively unrelated to the behavioral factors (BAC) and a closely related component to these factors (BAV)

To see that BAC is relatively unrelated to the behavioral-based factors, AFGP (2017) note that the long and short sides of BAC have similar average volatility, skewness, and MAX (the average of the five highest daily returns over the last month, which is a measure of preference for lottery-like returns)

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

The BAC portfolio

- At the beginning of each month, stocks are ranked based on the volatility at the end of the previous month

- The ranked stocks are assigned to one of five quintiles, $q = 1, 2, \ldots, 5$

- Within each quintile, stocks are ranked based on the estimate of correlation at the end of the previous month and assigned to one of the two portfolios: low correlation and high correlation (stock are weighted by ranked correlation)

- Both portfolios are (de)levered to have a beta of one

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

Then,

$$R_{t+1}^{BAC(q)} = \frac{1}{\beta_t^{L,q}}\left(R_{t+1}^{L,q} - R_f\right) - \frac{1}{\beta_t^{H,q}}\left(R_{t+1}^{H,q} - R_f\right);\ q = 1, 2, \ldots, 5$$

The return to the final BAC factor is given by

$$R_{t+1}^{BAC} = \frac{1}{5}\sum_{q=1}^{5} R_{t+1}^{BAC(q)}$$

BAV is constructed similarly to BAC, only stocks are first sorted into quintiles based on correlations instead of volatility

$$R_{t+1}^{BAV} = \frac{1}{5}\sum_{q=1}^{5} R_{t+1}^{BAV(q)}$$

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

KEY IDEA:

- Since stocks with low market correlation have low market betas, the theory of leverage constrains implies that BAC has positive (and significant) risk-adjusted returns, just like BAB

- However, the theory of leverage constraints implies that BAV should not have positive (and significant) risk-adjusted returns

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

BAC (1963-2015)	Coefficient	t-stat
Alpha	0.70%	5.45
Market Beta	0.02	0.5
SMB Beta	0.60	13.6
HML Beta	0.22	3.5
RMW Beta	0.02	0.3
CMA Beta	0.08	0.8
Adj R^2	0.27	

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

BAV (1963-2015)	Coefficient	t-stat
Alpha	-0.05%	-0.34
Market Beta	0.02	0.5
SMB Beta	0.60	13.6
HML Beta	0.22	3.5
RMW Beta	0.02	0.3
CMA Beta	0.08	0.8
Adj R^2	0.49	

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

BAB Economic Drivers (1963-2015)	Coefficient	t-stat
Δ Margin Debt	**5.74**	**3.17**
Δ Sentiment	**1.07**	**1.33**
Market Beta	0.16	4.4
SMB Beta	0.07	1.7
HML Beta	0.29	4.9
RMW Beta	0.48	7.6
CMA Beta	0.38	4.3
Adj R^2	0.25	

Margin debt is the amount of margin debt held against NYSE stocks as a fraction of total market equity

Sentiment is the sentiment index of Baker and Wurgler (JF 2006)

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

BAC Economic Drivers (1963-2015)	Coefficient	t-stat
Δ Margin Debt	**9.30**	**4.83**
Δ Sentiment	**1.24**	**1.44**
Market Beta	0.11	2.9
SMB Beta	0.55	12.0
HML Beta	0.23	3.7
RMW Beta	0.09	1.3
CMA Beta	0.11	1.2
Adj R^2	0.32	

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

► The strong performance of BAC (and the poor performance of BAV), and the evidence of their economic drivers suggest that the low-risk effect is explained by **leverage constraints** rather than by behavioral arguments

Funding Liquidity Risk: The Margin-Based Capital Asset Pricing Model

ASSET PRICING MODELS SHOULD SYSTEMATICALLY RECOGNIZE THE IMPORTANCE AND THE TIME-VARYING BEHAVIOR OF ILLIQUIDITY-RELATED MARKET AND FUNDING FRICTIONS

WHICH MANIFESTATION OF MARKET FRICTIONS (MARKET OR FUNDING ILLIQUIDITY) IS MORE RELEVANT FOR ASSET PRICING WITHIN A MULTI-BETA ASSET PRICING MODEL WITH TIME-VARYING EXPECTED RETURNS?