Realized semibetas:Disentangling “good” and “bad” downside risk （JFE202204）

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Contents

1. 研究背景

1.1 传统市场贝塔的局限性

-传统的市场贝塔是衡量股票回报与整体市场回报之间的相关性，它只考虑了股票回报的总体波动性，忽略了上行和下行市场的不对称性。

-早期的经验证据支持了传统市场贝塔的预测能力(Fama,1969;Blume,1970)，但随后的研究发现，传统市场贝塔无法令人满意地解释回报的横截面变化，估计的风险溢价通常过低，甚至是不显著的(Roll,1977;Bhandari，1988; Fama和French,1992)。

1. 研究背景

1.2 对股票回报非对称性的关注

-近年来，学者们开始关注股票回报的非对称性，即上行市场和下行市场的回报表现不同。(Kahneman和Tversky,1979; Farago和Tedongap,2018)

-资本资产定价模型(CAPM)的下行贝塔比传统的资本资产定价模型(CAPM)做得更好。(Ang 等人,2006a; Post和 van Vliet,2004; Lettau 等人,2014)

-质疑：下行贝塔值能否令人满意地解释近期美国和国际股票回报的横截面变化？(Atilgan 等人,2018 年; Levi 和 Welch,2020)

2. 主要发现

- 本文提出了一个新的四向分解:将传统市场贝塔分解到四个半贝塔。其中，高 β^N 的股票与显著高的未来收益相关;高 β^{M-}的股票与显著较低的未来回报率相关;而 β^P 和 β^{M+}似乎都没有显著的风险溢价。与其押注传统的市场贝塔，还不如押注“正确的”半贝塔。
- 每日半贝塔可能比根据日回报构建的每月贝塔度量能更好地揭示固有的非对称依赖关系。
- 多空半贝塔策略的年平均超额收益为 8.17%年化夏普比率为0.92。

3. 数据、变量和样本统计

数据

- 1963 年 1 月至2019年12月期间所有纽约证券交易所的普通股（股票代码10和11）（来自CRSP）
- 剔除了所有价格低于 5 美元的低价股。
- 总共得到了273,823 个月观测数据。

3. 数据、变量和样本统计

- **变量**
- **已实现半贝塔**
- 本文提出了一个新的四向分解:将传统市场贝塔分解到四个半贝塔。本文的分解依赖于 Bollerslev 等人(2020a)的半方差概念。

$$\beta \equiv \frac{Cov(r,f)}{Var(f)} = \frac{\mathcal{N}+\mathcal{P}+\mathcal{M}^{+}+\mathcal{M}^{-}}{Var(f)} \equiv \beta^{\mathcal{N}}+\beta^{\mathcal{P}}-\beta^{\mathcal{M}^{+}}-\beta^{\mathcal{M}^{-}}. \qquad (1)$$

- r和f分别表示某一风险资产和总市场投资组合的收益。N、P、M+ 和 M- 半协方差分量指的是总协方差 Cov(r, f) 的各个部分，分别定义为两个回报都是正的(“P”状态)，两个回报都是负的(“N”)，市场回报为正的混合符号(“M+"),市场回报为负的混合符号(“M”)。

3. 数据、变量和样本统计

- **变量**
- 由于混合符号半方差总是弱负数，较低的值表明较强的协变，为了便于解释本文实证分析中的风险溢价估计，本文特意将混合符号半方差定义为:

$$\beta^{M^+} = \frac{-M^+}{Var(f)} \qquad \beta^{M^-} = \frac{-M^-}{Var(f)}$$

- 设 $r_{t,k,i}$表示某固定时间段t内，资产i在第 k 个时间间隔内的高频收益，总市场的高频收益用 $f_{t,k}$ 表示。

$$r_{t,k,i}^{+} = \max(r_{t,k,i}, 0) \qquad r_{t,k,i}^{-} = \min(r_{t,k,i}, 0)$$

- 上式表示带符号的期间内资产收益，带符号的期间内市场收益也同样定义。

3. 数据、变量和样本统计

- **变量**
- 已实现的半贝塔如下定义:

$$\widehat{\beta}_{t,i}^{\mathcal{N}} \equiv \frac{\sum_{k=1}^{m} r_{t,k,i}^{-} f_{t,k}^{-}}{\sum_{k=1}^{m} f_{t,k}^{2}}, \quad \widehat{\beta}_{t,i}^{\mathcal{P}} \equiv \frac{\sum_{k=1}^{m} r_{t,k,i}^{+} f_{t,k}^{+}}{\sum_{k=1}^{m} f_{t,k}^{2}}$$

$$\widehat{\beta}_{t,i}^{\mathcal{M}^-} \equiv \frac{-\sum_{k=1}^{m} r_{t,k,i}^{+} f_{t,k}^{-}}{\sum_{k=1}^{m} f_{t,k}^{2}}, \quad \widehat{\beta}_{t,i}^{\mathcal{M}^+} \equiv \frac{-\sum_{k=1}^{m} r_{t,k,i}^{-} f_{t,k}^{+}}{\sum_{k=1}^{m} f_{t,k}^{2}} \qquad (2)$$

$$\widehat{\beta}_{t,i} \equiv \frac{\sum_{k=1}^{m} r_{t,k,i} f_{t,k}}{\sum_{k=1}^{m} f_{t,k}^{2}} = \widehat{\beta}_{t,i}^{\mathcal{N}} + \widehat{\beta}_{t,i}^{\mathcal{P}} - \widehat{\beta}_{t,i}^{\mathcal{M}^+} - \widehat{\beta}_{t,i}^{\mathcal{M}^-}. \qquad (3)$$

- 其中 m 为每个时间段内高频收益间隔的数量。

3. 数据、变量和样本统计

- **变量**
- Barndorff-Nielsen 和 Shephard(2004)表明，对于时间间隔越来越小的样本收益，已实现的贝塔能一致地估计真正的贝塔：

$$\widehat{\beta}_{t,i} \xrightarrow{p} \frac{\mathcal{COV}_{t,i}}{\mathcal{RV}_t}. \quad (4)$$

- Bollerslev 等人(2020a)关于已实现的半方差的填充渐近理论表明，已实现的半贝塔一致地估计真正的半贝塔：

$$\widehat{\beta}_{t,i}^{\mathcal{N}} \xrightarrow{p} \frac{\mathcal{N}_{t,i}}{\mathcal{RV}_t}, \widehat{\beta}_{t,i}^{\mathcal{P}} \xrightarrow{p} \frac{\mathcal{P}_{t,i}}{\mathcal{RV}_t}, \widehat{\beta}_{t,i}^{\mathcal{M}^+} \xrightarrow{p} \frac{-\mathcal{M}_{t,i}^{+}}{\mathcal{RV}_t},$$
$$\widehat{\beta}_{t,i}^{\mathcal{M}^-} \xrightarrow{p} \frac{-\mathcal{M}_{t,i}^{-}}{\mathcal{RV}_t}. \quad (5)$$

3. 数据、变量和样本统计

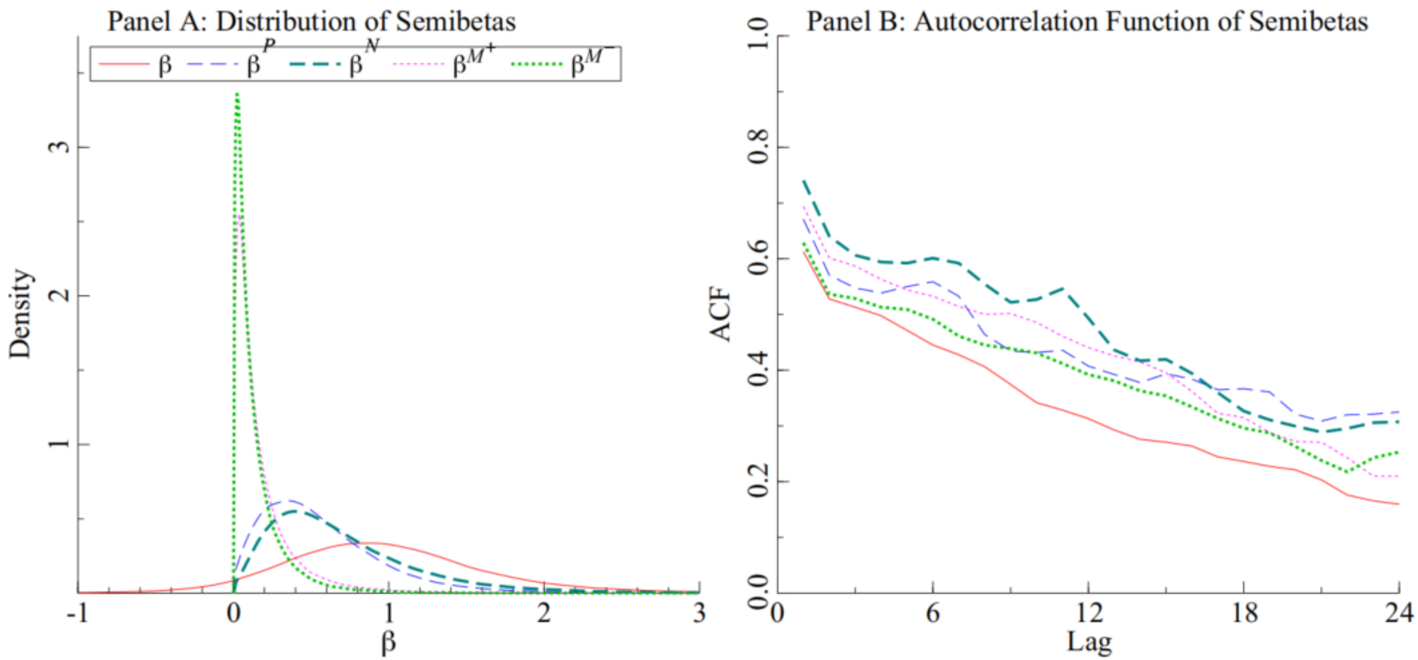

Fig. 2. Unconditional distributions and autocorrelations. Panel A displays kernel density estimates of the unconditional distribution of the monthly realized beta and semibetas averaged across time and stocks. Panel B reports the average autocorrelation functions for the monthly realized beta and semibetas averaged across stocks. The estimates are based on all of the common, non-penny, stocks in the CRSP database from January 1963 to December 2019.

3. 数据、变量和样本统计

Table 1
Summary Statistics. Panel A reports the time series averages of the cross-sectional means, medians and standard deviations for the monthly realized semibetas constructed from daily returns. Panel B reports the time series averages of the cross-sectional correlations. The estimates are based on all of the common, non-penny, stocks in the CRSP database from January 1963 to December 2019.

	β	$\beta^{\mathcal{N}}$	$\beta^{\mathcal{P}}$	$\beta^{\mathcal{M}^+}$	$\beta^{\mathcal{M}^-}$
Panel A: Summary statistics					
Mean	0.99	0.60	0.76	0.21	0.16
Median	0.92	0.54	0.67	0.15	0.10
St.Dev.	0.76	0.36	0.46	0.21	0.19
Panel B: Correlations					
β	1.00	0.72	0.79	-0.30	-0.29
$\beta^{\mathcal{N}}$		1.00	0.42	0.10	-0.09
$\beta^{\mathcal{P}}$			1.00	-0.07	0.06
$\beta^{\mathcal{M}^+}$				1.00	0.23
$\beta^{\mathcal{M}^-}$					1.00

相比传统市场贝塔，**半贝塔确实传达了不同的、潜在的有用的信息。**

4. 半贝塔和预期横截面收益

本文通过Fama 和 MacBeth(1973)横截面预测回归估计不同半贝塔的t+1月风险溢价(λs):

$$r_{t+1,i} = \lambda_{0,t+1} + \lambda_{t+1}^{\mathcal{N}} \hat{\beta}_{t,i}^{\mathcal{N}} + \lambda_{t+1}^{\mathcal{P}} \hat{\beta}_{t,i}^{\mathcal{P}} + \lambda_{t+1}^{\mathcal{M}^+} \hat{\beta}_{t,i}^{\mathcal{M}^+} + \lambda_{t+1}^{\mathcal{M}^-} \hat{\beta}_{t,i}^{\mathcal{M}^-} + \epsilon_{t+1,i}. \qquad (6)$$

基于这些 T-1 截面估计，然后本文通过样本中所有月份的时间序列平均值估计与每个半贝塔相关的平均风险溢价:

$$\hat{\lambda}^j = \frac{1}{T-1} \sum_{t=2}^{T} \hat{\lambda}_t^j \quad j = \mathcal{N}, \mathcal{P}, \mathcal{M}^+, \mathcal{M}^-. \qquad (7)$$

4. 半贝塔和预期横截面收益

4.1标准风险因子和控制条件

Table 2

Monthly Fama-MacBeth regressions. The table reports the estimated annualized risk premia and Newey-West robust *t*-statistics from overlapping monthly Fama-MacBeth cross-sectional predictive regressions. The monthly semibetas are calculated from daily data. All of the control variables are measured on the day prior to the monthly returns. The estimates are based on all of the common, non-penny, stocks in the CRSP database from January 1963 to December 2019.

β	$\beta^{\mathcal{N}}$	$\beta^{\mathcal{P}}$	$\beta^{\mathcal{M}^+}$	$\beta^{\mathcal{M}^-}$	ME	BM	MOM	REV	RV	IVOL	ILLIQ	R^2
4.27												2.33
3.96												
	10.54	1.84	4.59	-6.00								5.16
	4.51	1.17	1.32	-1.97								
	8.74	0.25	5.72	-13.55	-2.56	-0.64	0.05					10.55
	3.61	0.16	1.51	-3.68	-5.05	-0.57	2.05					
	9.78	2.56	8.01	-11.84	-4.82	-1.14	0.06	-0.12	-0.71	0.52	-2.81	13.85
	3.80	1.26	1.89	-3.03	-5.31	-1.00	2.22	-2.07	-1.87	0.39	-4.47	

4. 半贝塔和预期横截面收益

4.2套利风险和半贝塔定价：

Pontiff(1996)和 Schleifer and Vishny(1997)所认为的，由于制度阻碍了许多机构投资者做空，而许多个人投资者只是不愿做空，这可能会有效地产生套利限制和相关的套利风险(Hong 和 Sraer, 2016)。这种套利风险反过来可能导致与多头和空头头寸相关的系统性风险的定价不同。

本文遵循文献,使用特质波动率(IVOL)作为套利风险的指标(Pontiff,1996; Stambaugh 等人,2015)。IVOL 越高意味着价格修正套利的障碍越大。因此，本文将股票的横截面分成高和低IVOL 的股票组，并比较每组的风险溢价估计。

4. 半贝塔和预期横截面收益

为了便于对两个单独的IVOL 组的 λ^N=-λ^{M-}的假设进行直接检验，本文将(6)中的横截面回归重新参数化为:

$$r_{t+1,i} = \lambda_{0,t+1} + \lambda^{\mathcal{N}}_{t+1}(\hat{\beta}^{\mathcal{N}}_{t,i} - \hat{\beta}^{\mathcal{M}^-}_{t,i}) + \lambda^{\mathcal{P}}_{t+1}(\hat{\beta}^{\mathcal{P}}_{t,i} - \hat{\beta}^{\mathcal{M}^+}_{t,i}) + \delta^{\mathcal{M}^+}_{t+1}\hat{\beta}^{\mathcal{M}^+}_{t,i} + \delta^{\mathcal{M}^-}_{t+1}\hat{\beta}^{\mathcal{M}^-}_{t,i} + \epsilon_{t+1,i}. \quad (9)$$

$$\hat{\delta}^{\mathcal{M}^-} = \frac{1}{T-1}\sum_{t=2}^{T}\hat{\delta}^{\mathcal{M}^-}_t. \quad (10)$$

结果发现，IVOL最低的 50%样本中，结果 δ^{M-}的估计值为 3.84，t统计值不显著 (1.02)。另一方面，与β^N 和-β^{M-}的不同风险溢价可能归因于套利风险的论文一致，对于具有**最高 IVOL 的 50%股票中，其δ^{M-}估计为10.98，具有显著的t统计量为 2.59.**

4. 半贝塔和预期横截面收益

为了进一步论证套利风险和估值不确定性所发挥的作用，本文还考虑基于换手率(TO)的分组估计。一般认为，难以估值和投资者意见分歧较大的股票的换手率较高(例如，Harris 和Raviv1993;Blume 1994)。因此，高换手率的股票也可能造成更大的套利价格差异(例如，Kumar 2009)。

与此观点一致的是，TO 分组的估计结果与IVOL 分组的结果大致相同: 对于较高的50%TO的股票， δ^{M-}的估计(t统计量)为 8.38(2.30),因此对股票估值更困难,而对于较低的50%TO的股票， δ^{M-}的估计(t 统计量)为 5.60(1.22)，因此股票的套利风险较小。

4. 半贝塔和预期横截面收益

4.3上行和下行贝塔：

Ang 等人(2006a)在被广泛引用的研究中提出的上行和下行贝塔，其中已实现的贝塔版本被定义为:

$$\hat{\beta}^{+}_{t,i} \equiv \frac{\sum_{k=1}^{m} r_{t,k,i} f^{+}_{t,k}}{\sum_{k=1}^{m} (f^{+}_{t,k})^2}, \qquad \hat{\beta}^{-}_{t,i} \equiv \frac{\sum_{k=1}^{m} r_{t,k,i} f^{-}_{t,k}}{\sum_{k=1}^{m} (f^{-}_{t,k})^2}. \qquad (11)$$

$$\hat{\beta}^{+}_{t,i} = (\widehat{\beta}^{\mathcal{P}}_{t,i} - \widehat{\beta}^{\mathcal{M}^+}_{t,i}) \frac{\sum_{k=1}^{m} f^2_{t,k}}{\sum_{k=1}^{m} (f^{+}_{t,k})^2},$$

$$\hat{\beta}^{-}_{t,i} = (\widehat{\beta}^{\mathcal{N}}_{t,i} - \widehat{\beta}^{\mathcal{M}^-}_{t,i}) \frac{\sum_{k=1}^{m} f^2_{t,k}}{\sum_{k=1}^{m} (f^{-}_{t,k})^2}.$$

4. 半贝塔和预期横截面收益

Table 3

Monthly Fama-MacBeth regressions and other measures. The table reports the estimated annualized risk premia and Newey-West robust *t*-statistics from overlapping monthly Fama-MacBeth cross-sectional predictive regressions. The monthly semibetas, up and downside betas, coskewness and cokurtosis measures are calculated from daily data. The estimates are based on all of the common, non-penny, stocks in the CRSP database from January 1963 to December 2019.

$\beta^{\mathcal{N}}$	$\beta^{\mathcal{P}}$	$\beta^{\mathcal{M}^+}$	$\beta^{\mathcal{M}^-}$	β^+	β^-	CSK	CKT	R^2
10.54	1.84	4.59	-6.00					5.16
4.51	1.17	1.32	-1.97					
				1.21	3.23			3.41
				1.85	3.84			
11.53	-2.30	2.82	-11.20	-6.21	1.84			5.48
3.50	-0.55	1.34	-2.90	-0.97	1.27			
						5.44	2.13	1.68
						3.05	2.77	
18.03	-1.59	3.70	-11.32			12.13	-2.64	6.40
5.02	-0.76	1.09	-3.31			4.36	-3.41	

4.4协偏度和协峰度

5. 高频数据和每日半贝塔

- 由日回报构建的月实现半贝塔可能会掩盖更微妙的非常规性的依赖关系，这将由更高频率的日内回报构建的日实现半贝塔揭示出来。

- 本文的分析依赖于从交易和报价(TAQ)数据库中获得的高频数据。本文包括了1993年1月至2019年12月样本期内标准普尔500 成分股的所有成分股，总共有6799 个交易日和1182只证券。本文采用15分钟采样方案，或每天m=26个收益观测，用于计算已实现的半贝塔指标。

Table 4

Daily Fama-MacBeth regressions The table reports the estimated annualized risk premia and Newey-West robust t-statistics from daily Fama-MacBeth cross-sectional predictive regressions. The daily semibetas are calculated from 15-minute intraday data. All of the control variables are measured prior to the daily returns, as detailed in Appendix A. The estimates are based on all of the S&P 500 constituent stocks and days in the January 1993 to December 2019 sample period.

β	$\beta^{\mathcal{N}}$	$\beta^{\mathcal{P}}$	$\beta^{\mathcal{M}^+}$	$\beta^{\mathcal{M}^-}$	ME	BM	MOM	REV	RV	IVOL	ILLIQ	R^2
4.49												2.57
3.42												
	18.10	-0.23	-4.49	-7.82								5.42
	5.40	-0.09	-1.14	-2.19								
	19.02	-4.10	-2.63	-11.41	-1.78	-2.01	0.09					8.62
	5.86	-1.64	-0.73	-3.27	-3.63	-1.94	3.36					
	18.79	-1.57	2.33	-7.18	-2.70	-2.64	0.08	-0.43	0.43	-3.26	-0.83	11.23
	5.87	-0.61	0.68	-2.02	-4.62	-2.55	2.83	-5.20	2.16	-4.45	-2.62	

Table 5

Daily Fama-MacBeth regressions on other measures The table reports the estimated annualized risk premia and Newey-West robust t-statistics from daily Fama-MacBeth cross-sectional predictive regressions. The daily semibetas, up and downside betas, and coskewness and cokurtosis measures are calculated from 15-minute intraday data based on all of the S&P 500 constituent stocks and days in the January 1993 to December 2019 sample period.

$\beta^{\mathcal{N}}$	$\beta^{\mathcal{P}}$	$\beta^{\mathcal{M}^+}$	$\beta^{\mathcal{M}^-}$	β^+	β^-	CSK	CKT	R^2
18.10	-0.23	-4.49	-7.82					5.42
5.40	-0.09	-1.14	-2.19					
				-0.37	5.71			3.60
				-0.38	5.32			
15.84	-8.69	7.76	-11.13	-4.27	2.10			6.48
3.89	-1.03	0.78	-2.16	-1.05	0.78			
						-1.86	0.88	1.51
						-0.71	0.96	
26.21	-2.19	-5.06	-14.99			10.93	-3.71	6.31
6.28	-0.73	-1.20	-4.00			3.18	-3.68	

5. 高频数据和每日半贝塔

- 5.1每日半贝塔和更长的投资期限
- 基于每日半贝塔的相同预测关系是否会延续到更长的投资期限?
- 本文依赖于相同的第t天已实现的半贝塔和横截面回归(6)(本文用t+1到t+h 的累积回报替换日回报，设置h=5和h=20，分别对应于一个星期或者一个月)。

Table 6

Daily semibetas and weekly and monthly investment horizons. The table reports the estimated annualized risk premia and Newey-West robust *t*-statistics from daily Fama-MacBeth cross-sectional regressions for predicting the future weekly (5-days) and monthly (20-days) returns. The daily semibetas are calculated from 15-minute intraday data on the last day preceding the return window. All of the control variables are measured prior to the daily returns. The estimates are based on all of the S&P 500 constituent stocks and days in the January 1993 to December 2019 sample period.

β	$\beta^{\mathcal{N}}$	$\beta^{\mathcal{P}}$	$\beta^{\mathcal{M}^+}$	$\beta^{\mathcal{M}^-}$	ME	BM	MOM	REV	RV	IVOL	ILLIQ	R^2
Panel A: Weekly												
4.74												2.29
4.47												
	12.42	1.28	6.34	-12.30								5.09
	5.98	0.79	2.72	-4.13								
	9.26	0.89	2.38	-12.38	-3.20	-2.77	0.08	-0.30	0.16	-0.99	-0.98	11.44
	5.37	0.60	1.44	-4.33	-5.94	-2.84	2.74	-4.31	1.46	-1.55	-3.99	
Panel B: Monthly												
2.73												1.85
3.07												
	7.20	1.51	3.18	-3.66								4.41
	4.45	1.24	1.70	-1.65								
	4.40	0.56	-0.23	-5.82	-2.82	-2.50	0.07	-0.23	-0.16	0.51	-0.62	11.19
	3.53	0.53	-0.18	-2.80	-6.34	-2.96	2.61	-4.33	-1.93	0.92	-3.76	

6. 押注和反押半贝塔

- 本文除了押注 βN和反押注 βM-的投资组合之外，本文还考虑由押注 βN和反押注 βM-投资组合的等权重组合构成的半贝塔策略。

- 构建方法：
- 1.从高频计量经济学的方法估计贝塔和半贝塔
- 2.在股票的头部五分位数中持有市值加权的多头头寸，在底部五分位数中持有市值加权的空头头寸，每天进行重新平衡，得到零成本投资组合。

6. 押注和反押半贝塔

Table 7

Betting on and against semibetas. The top panel reports annualized descriptive statistics of the betting on and against (semi)beta strategies. The $\beta^{\mathcal{N}}$ strategy bets on $\beta^{\mathcal{N}}$, the $\beta^{\mathcal{M}^-}$ strategy bets against $\beta^{\mathcal{M}^-}$, while the Semi-β strategy represents an equally-weighted combination of the former two strategies. All of the portfolios are self-financing based on value-weighted long-short positions rebalanced daily. The bottom panel reports the time-series regression estimates and Newey-West robust t-statistics for the FFC4 and FF5 factor models, along with the corresponding alphas in annualized percentage terms. The estimates are based on all of the S&P 500 constituent stocks and days in the 1993–2019 sample.

	β		Semi-β		$\beta^{\mathcal{N}}$		$\beta^{\mathcal{M}^-}$	
Avg ret	5.62		8.17		10.02		5.56	
Std dev	15.37		8.86		15.78		7.80	
Sharpe	0.37		0.92		0.63		0.71	
α	2.52	3.94	6.84	7.52	6.89	8.59	6.02	5.68
	1.21	1.98	5.92	6.49	3.31	4.22	3.93	3.65
β_{MKT}	0.57	0.50	0.28	0.25	0.59	0.51	-0.02	-0.01
	75.03	62.98	67.31	53.06	76.91	62.03	-3.22	-2.28
β_{SMB}	0.27	0.15	0.31	0.24	0.39	0.26	0.23	0.22
	18.94	10.67	38.92	28.43	27.12	17.78	21.88	19.12
β_{HML}	-0.01	0.22	-0.01	0.16	-0.06	0.20	0.04	0.12
	-0.42	14.59	-1.10	17.85	-3.98	12.61	3.72	9.97
β_{MOM}	-0.21		-0.16		-0.22		-0.10	
	-20.47		-27.83		-21.16		-13.06	
β_{RMW}		-0.42		-0.25		-0.46		-0.03
		-21.65		-21.46		-22.80		-2.13
β_{CMA}		-0.33		-0.24		-0.40		-0.08
		-14.01		-17.42		-16.37		-4.48
R^2	56.11	58.20	55.83	56.68	58.98	61.96	10.19	8.02

6. 押注和反押半贝塔

Table 8

Betting on the competition. The top panel reports annualized descriptive statistics of portfolios formed using up and downside betas, and coskewness and cokurtosis measures, designed to bet on β^-, against β^+, against *CSK*, and on *CKT*. All of the portfolios are self-financing based on value-weighted long-short positions rebalanced daily. The bottom panel reports the time-series regression estimates and Newey-West robust *t*-statistics for the FFC4 and FF5 factor models, along with the corresponding alphas in annualized percentage terms. The estimates are based on all of the S&P 500 constituent stocks and days in the 1993–2019 sample period.

	β^- - β^+		β^-		β^+		CKT - CKS		CSK		CKT	
Avg ret	1.83		7.11		-5.12		-0.19		-1.91		1.96	
Std dev	5.34		14.46		13.58		6.11		7.49		9.17	
Sharpe	0.34		0.49		-0.38		0.03		-0.25		0.21	
α	1.46	1.78	4.15	5.64	-2.92	-3.75	-0.56	0.02	-2.12	-1.98	0.67	1.69
	1.33	1.63	1.95	2.70	-1.42	-1.87	-0.52	0.02	-1.42	-1.32	0.43	1.11
β_{MKT}	0.04	0.03	0.52	0.45	-0.45	-0.40	0.13	0.11	0.02	0.01	0.24	0.20
	8.87	5.91	66.70	53.85	-59.32	-49.73	33.19	25.54	2.86	2.11	42.74	33.18
β_{SMB}	0.01	0.01	0.25	0.15	-0.22	-0.13	-0.03	-0.06	0.02	0.03	-0.09	-0.14
	1.66	1.35	17.21	9.92	-15.90	-8.79	-4.50	-7.37	2.37	2.37	-8.43	-12.49
β_{HML}	-0.02	-0.03	-0.03	0.16	-0.02	-0.23	-0.08	-0.05	-0.02	-0.04	-0.13	-0.07
	-2.86	-3.86	-1.81	10.12	-1.21	-14.91	-10.22	-6.62	-2.20	-3.49	-11.91	-5.75
β_{MOM}	0.03		-0.15		0.22		0.00		0.03		-0.03	
	5.62		-14.73		21.42		-0.82		3.49		-4.41	
β_{RMW}		-0.01		-0.37		0.35		-0.10		0.00		-0.20
		-1.20	0.00	-18.07	0.00	17.54	0.00	-9.18	0.00	0.25	0.00	-12.92
β_{CMA}		-0.01		-0.30		0.27		-0.05		0.01		-0.12
		-1.13		-12.13		11.51		-4.38		0.67		-6.67
R^2	2.19	1.71	50.24	52.95	47.83	48.07	16.30	17.70	0.64	0.45	26.09	28.55

Table 9

Betting on and against semibetas with weekly rebalancing. The top panel reports annualized descriptive statistics of the betting on and against (semi)beta strategies. The $\beta^{\mathcal{N}}$ strategy bets on $\beta^{\mathcal{N}}$, the $\beta^{\mathcal{M}^-}$ strategy bets against $\beta^{\mathcal{M}^-}$, while the Semi-β strategy represents an equally-weighted combination of the former two strategies. All of the portfolios are self-financing based on value-weighted long-short positions rebalanced weekly. The bottom panel reports the time-series regression estimates and Newey-West robust t-statistics for the FFC4 and FF5 factor models, along with the corresponding alphas in annualized percentage terms. The estimates are based on all of the S&P 500 constituent stocks and days in the 1993-2019 sample period.

	β		Semi-β		$\beta^{\mathcal{N}}$		$\beta^{\mathcal{M}^-}$	
Avg ret	2.33		4.91		6.71		2.41	
Std dev	14.24		8.31		14.57		7.44	
Sharpe	0.16		0.59		0.46		0.32	
α	-0.29	0.95	3.83	4.45	4.21	5.49	2.74	2.71
	-0.14	0.48	3.40	3.84	2.21	2.85	1.95	1.91
β_{MKT}	0.50	0.44	0.24	0.20	0.50	0.44	-0.02	-0.03
	66.99	56.06	57.40	43.90	71.40	56.45	-4.73	-4.81
β_{SMB}	0.26	0.16	0.31	0.25	0.37	0.26	0.25	0.23
	19.05	11.00	40.21	29.34	28.56	18.84	25.74	22.35
β_{HML}	-0.06	0.13	-0.04	0.09	-0.09	0.12	0.01	0.06
	-4.14	8.38	-5.10	10.33	-6.93	8.48	1.15	5.25
β_{MOM}	-0.18		-0.13		-0.20		-0.06	
	-18.29		-23.50		-21.68		-8.09	
β_{RMW}		-0.40		-0.22		-0.40		-0.05
		-20.56		-19.68		-21.02		-3.74
β_{CMA}		-0.24		-0.18		-0.31		-0.05
		-10.46		-12.98		-13.57		-2.79
R^2	50.76	52.63	47.95	48.92	52.68	54.52	10.21	9.65

Table 10

Betting on and against semibetas with monthly rebalancing. The top panel reports annualized descriptive statistics of the betting on and against (semi)beta strategies. The $\beta^{\mathcal{N}}$ strategy bets on $\beta^{\mathcal{N}}$, the $\beta^{\mathcal{M}^-}$ strategy bets against $\beta^{\mathcal{M}^-}$, while the Semi-β strategy represents an equally weighted combination of the former two strategies. All of the portfolios are self-financing based on value-weighted long-short positions rebalanced monthly. The bottom panel reports the time-series regression estimates and Newey-West robust t-statistics for the FFC4 and FF5 factor models, along with the corresponding alphas in annualized percentage terms. The estimates are based on all of the S&P 500 constituent stocks and days in the 1993-2019 sample period.

	β		Semi-β		$\beta^{\mathcal{N}}$		$\beta^{\mathcal{M}^-}$	
Avg ret	0.14		3.44		2.87		3.39	
Std dev	13.52		8.10		13.87		7.16	
Sharpe	0.01		0.42		0.21		0.47	
α	-2.10	-1.17	2.41	3.03	0.69	1.75	3.50	3.70
	-1.09	-0.63	2.13	2.65	0.37	0.94	2.76	2.90
β_{MKT}	0.45	0.41	0.22	0.19	0.45	0.40	0.00	-0.01
	63.99	53.91	53.84	41.86	65.75	53.05	-0.50	-2.26
β_{SMB}	0.23	0.13	0.31	0.25	0.36	0.25	0.27	0.25
	17.68	9.32	40.62	30.25	28.21	18.72	31.07	26.98
β_{HML}	-0.07	0.09	-0.04	0.07	-0.06	0.14	-0.03	0.01
	-5.21	5.97	-5.64	8.39	-4.89	9.85	-3.05	0.53
β_{MOM}	-0.18		-0.12		-0.21		-0.03	
	-19.35		-21.77		-22.74		-5.11	
β_{RMW}		-0.38		-0.23		-0.39		-0.07
		-20.67		-20.13		-21.24		-5.19
β_{CMA}		-0.16		-0.15		-0.26		-0.04
		-7.12		-11.14		-11.88		-2.83
R^2	46.84	47.90	46.72	47.86	49.71	50.86	12.76	12.94

Table 11

Betting on and against semibetas with transaction costs. The top panel reports annualized descriptive statistics for the Semi-β portfolios, constructed as an equally-weighted combination of $\beta^{\mathcal{N}}$ portfolios that bet on $\beta^{\mathcal{N}}$, and $\beta^{\mathcal{M}^-}$ portfolios that bet against $\beta^{\mathcal{M}^-}$. The bottom panel reports the time-series regression estimates and Newey-West robust t-statistics for the FFC4 and FF5 factor models, along with the corresponding alphas in annualized percentage terms. All of the portfolios are self-financing based on value-weighted long-short positions determined by the combined semibeta strategy rebalanced monthly. The roundtrip transaction cost (T-cost) is set to 0.5%. The two left-most columns are identical to the second set of columns in Table 10 with fully adjusted portfolio weights. The second set of columns incorporate transaction costs. The right two sets of columns report the results based on partially-adjusted portfolio weights as discussed in the main text, without and with transaction costs. The estimates are based on all of the S&P 500 constituent stocks and days in the 1993-2019 sample period.

Adjustment	Full		Full		Partial		Partial	
T-cost	No		Yes		No		Yes	
Avg ret	3.44		-2.75		3.75		3.46	
Std dev	8.10		8.29		7.32		7.32	
Sharpe	0.42		-0.33		0.51		0.47	
α	2.41	3.03	-3.79	-3.15	2.22	3.65	1.93	3.36
	2.13	2.65	-3.34	-2.75	2.45	4.12	2.12	3.79
β_{MKT}	0.22	0.19	0.22	0.19	0.23	0.18	0.23	0.18
	53.84	41.86	54.12	41.89	70.22	50.54	70.19	50.50
β_{SMB}	0.31	0.25	0.32	0.25	0.28	0.23	0.28	0.23
	40.62	30.25	40.84	30.27	46.11	35.67	46.09	35.64
β_{HML}	-0.04	0.07	-0.04	0.08	-0.10	-0.03	-0.10	-0.03
	-5.64	8.39	-5.17	8.71	-15.62	-4.48	-15.60	-4.46
β_{MOM}	-0.12		-0.12		-0.01		-0.01	
	-21.77		-21.59		-2.80		-2.80	
β_{RMW}		-0.23		-0.23		-0.22		-0.22
		-20.13		-20.54		-25.11		-25.11
β_{CMA}		-0.15		-0.15		-0.17		-0.17
		-11.14		-11.03		-16.22		-16.21
R^2	46.72	47.86	44.81	46.08	50.91	56.90	50.89	56.89

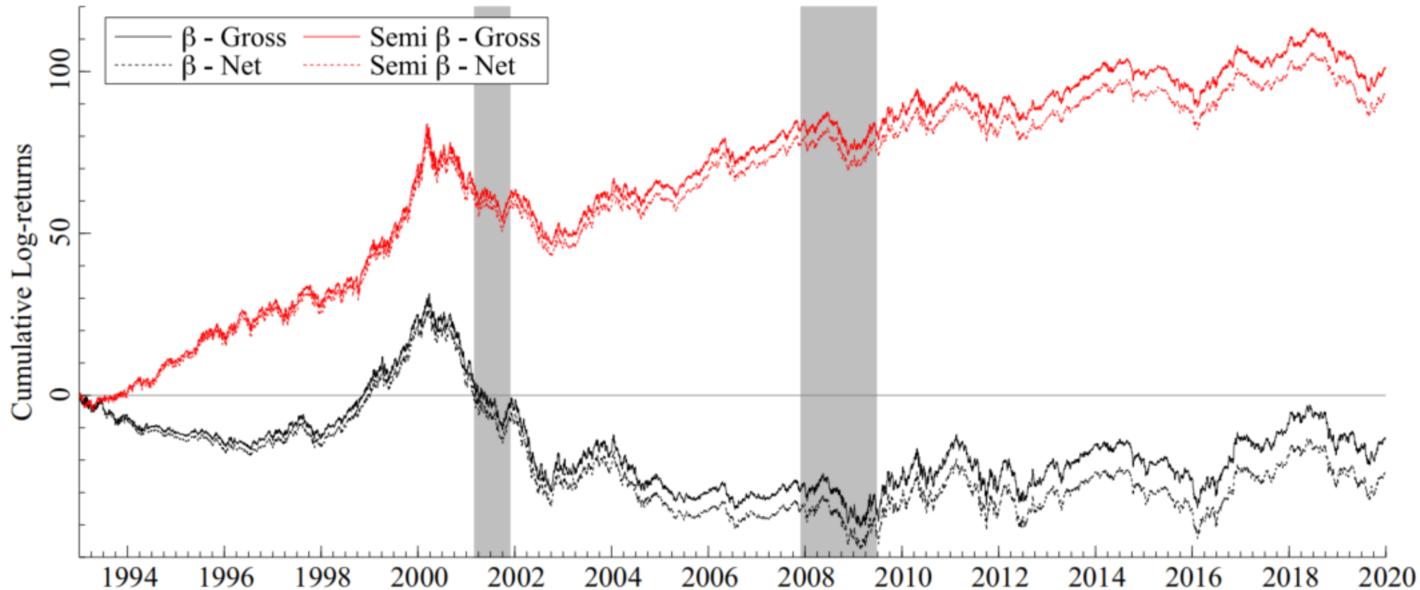

Fig. 3. Cumulative returns for beta and semibeta long-short portfolio strategies. The figure plots the cumulative percentage returns of long-short strategies based on beta and semibeta sorted value-weighted quintile portfolios. The semibeta portfolios are constructed as an equally-weighted combination of $\beta^{\mathcal{N}}$ portfolios that bet on $\beta^{\mathcal{N}}$, and $\beta^{\mathcal{M}^-}$ portfolios that bet against $\beta^{\mathcal{M}^-}$. The shaded region represents NBER recession periods. The beta estimates and portfolio returns are based on all of the S&P 500 constituent stocks and days in the 1993-2019 sample.

7. 结论

- 本文提出了一种将传统市场贝塔分解为四个半贝塔的新方法。发现只有两个与负市场回报变化相关的半贝塔被定价。β^N的风险溢价大约是$-\beta^{M-}$的两倍,大约是传统市场β风险溢价的三倍。
- 本文进一步建立了简单的交易策略，夏普比率超过传统市场β的两倍。
- 与其押注和反押住传统贝塔，不如换为半贝塔。

谢谢大家！
请各位老师和同学们批评指正！