

Initial Public Offerings: An Asset Allocation Perspective

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Presentation Outline

- Introduction
- Motivation of Research
- Methodology: Tests of Mean-Variance Spanning
- Data and Empirical Results
- Conclusions and Future Research

Introduction

- Some main research issues on IPOs
 - Underpricing
 - Hot issue markets
 - Long-run performance
- Whether adding IPO stocks could significantly enlarge mean-variance investment opportunity set has not been studied in the literature.

Motivation

- The existence of “IPO plus Aftermarket Fund”
- To general fund managers, whether to include IPO stocks like Yahoo or Google in their fund portfolios?
- Can mean-variance investors benefit from investing in a portfolio of IPO stocks?
- Applying mean-variance analysis:
 - IPO as a *New Asset* to the capital market.
 - The *Economic Value* of IPO investment for mean-variance investors.

Research questions

- Can an IPO portfolio significantly enlarge investors' *Investment Opportunity Set* relative to currently traded stocks?
- To what extent could an IPO portfolio enhance the gain of diversification?
- What characteristics of an IPO portfolio can help gain the benefit of diversification?

Mean-Variance Spanning (I)

- Can adding a new set of risky assets enlarge the mean-variance frontier of a given set of assets?
- Huberman and Kandel (1987)
 - A regression-based multivariate test of whether the minimum-variance frontier of a set of K benchmark assets is the same as the minimum-variance frontier of the K assets plus a set of N test assets.
- Kan and Zhou (2001): step down tests

Mean-Variance Spanning (II)

- Consider $K(R_{1t})$ basis assets and $N(R_{2t})$ test assets.

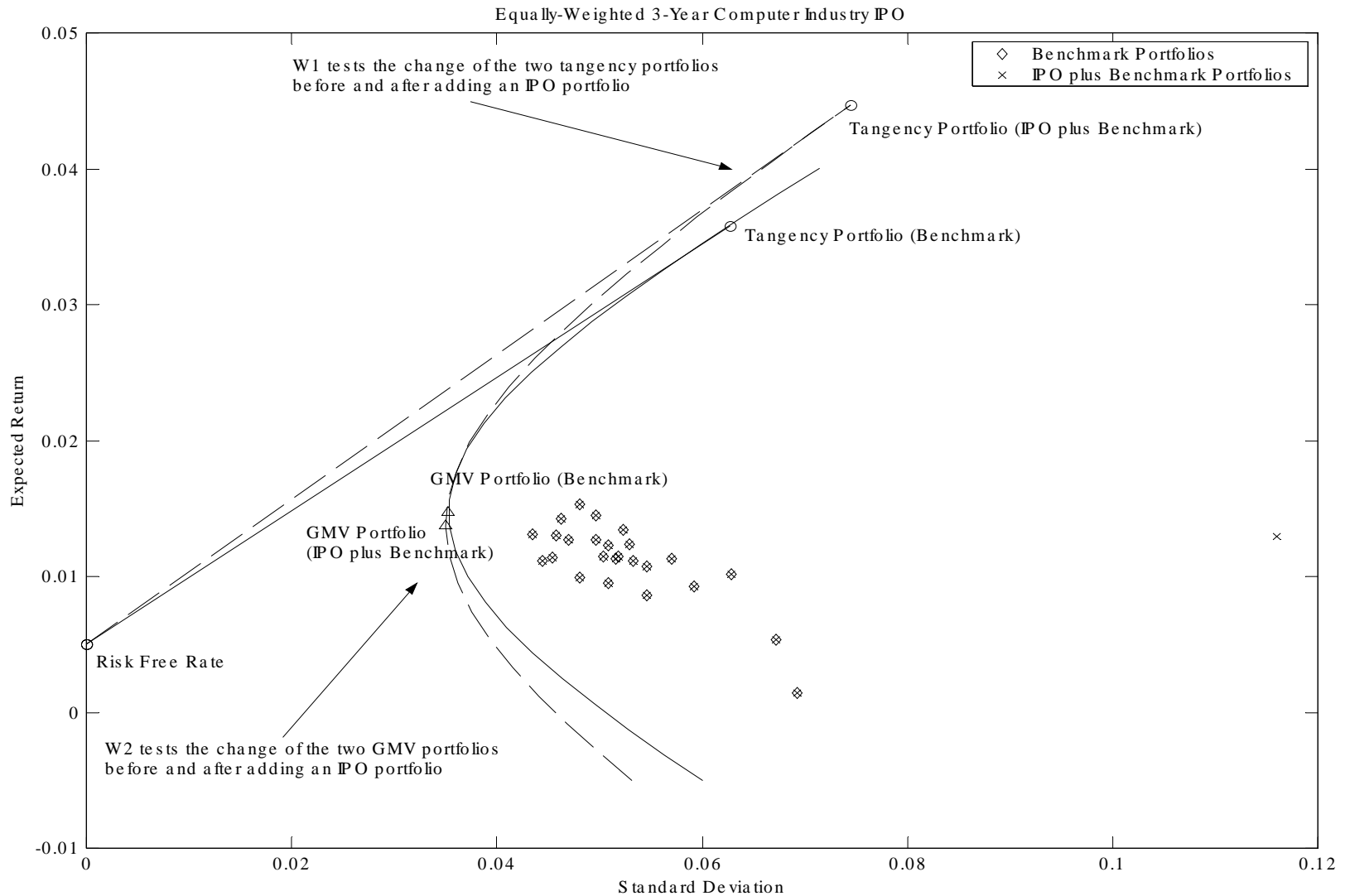
$$R_{2t} = \alpha + \beta R_{1t} + \xi_t$$

- $H_0: \alpha = 0_N \quad \delta = 1_N - \beta 1_K = 0_N$
- Three asymptotic tests in chi-square distributions with $2N$ degree of freedom. (Kan and Zhou (2001))
 - Likelihood ratio test
 - Lagrange multiplier test
 - Wald test
- Exact finite sample likelihood ratio test is an F distribution. (Huberman and Kandel (1987) and Jobson and Korkie (1989))

Step-Down Tests

- Kan and Zhou (2001) suggest a new step-down procedure for the spanning tests.
 - First, we test $\alpha = 0_N$.
 - Second, we test $\delta = 0_N$ conditional on $\alpha = 0_N$.
- Reject the first test: two tangency portfolios are very different.
- Reject the second test: two global minimum-variance portfolios are very different.

Geometry of the Spanning Test



Data (I)

- 6,961 U.S. IPOs from 1977-2002

- (1) The IPOs involve common stocks only. Unit offers, REITs, closed-end funds, ADRs, and reverse leveraged buyouts are excluded.
- (2) The IPO firms must have return data in the CRSP database.
- (3) The offer price is greater than or equal to \$5.

- Equally/Value-weighted 1-year and 3-year IPO portfolios from 1980-2002

- Venture backed and non-venture backed IPOs

Barry, Muscarella, Peavy, and Vetsuypens (1990)

Meggison and Weiss (1991)

Brav and Gompers (1997)

Data (II)

- **IPOs with/without prestigious underwriters**

Logue (1973), Beatty and Ritter (1986), Booth and Smith (1986), Carter and Manaster (1990), Beatty and Welch (1996), Carter, Dark, and Singh (1998), and Logue, Rogalski, Seward, and Foster-Johnson (2002)

- **Nine Industry IPO portfolios**

Mauer and Senbet (1992), Benveniste, Ljungqvist, Wilhelm, and Yu (2003), Ritter (1991) and Brav (2000)

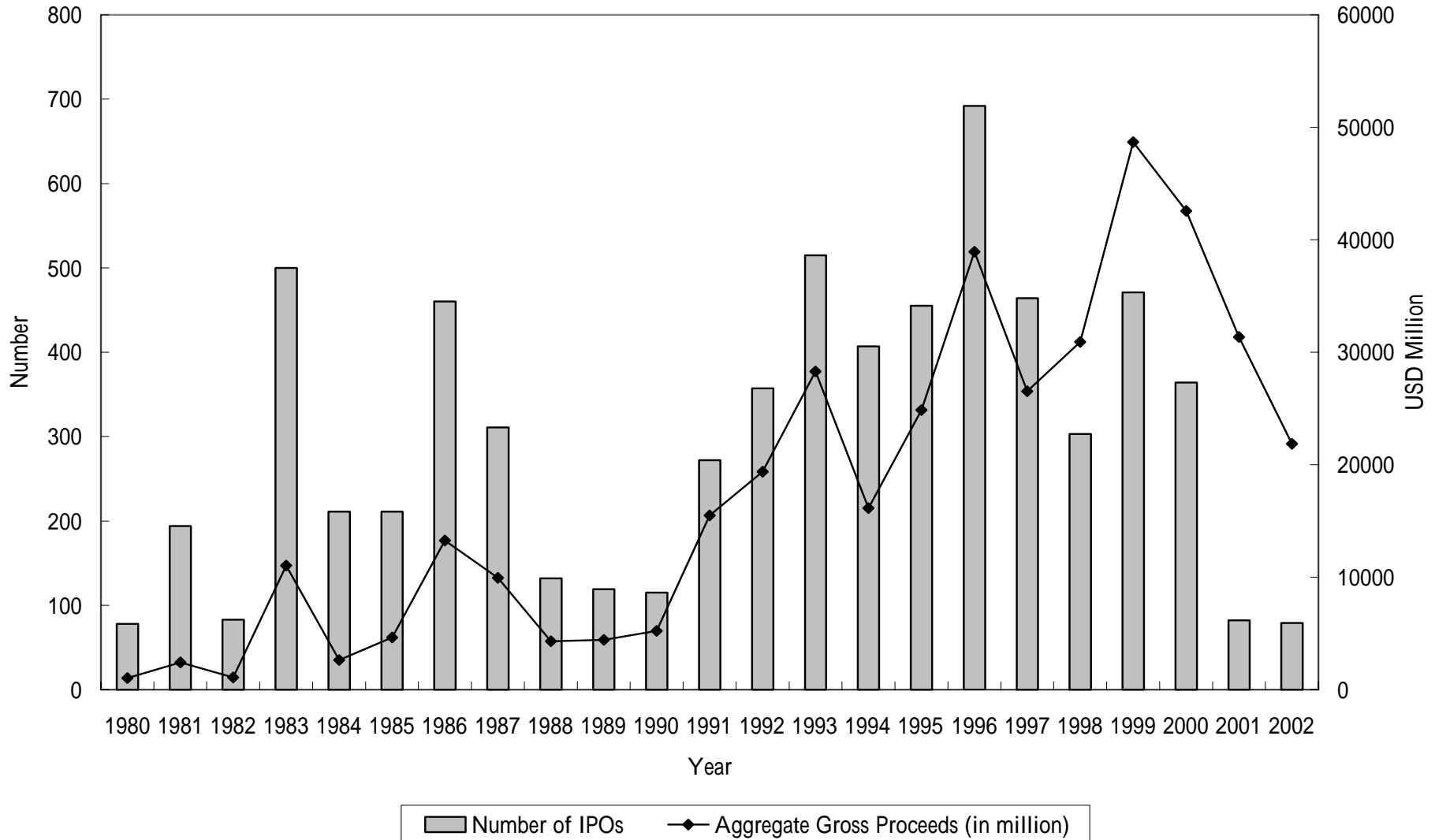
- **Benchmark portfolios: 25 decontaminated size/book-to-market ratio portfolios from U.S. common stocks.**

Table 1

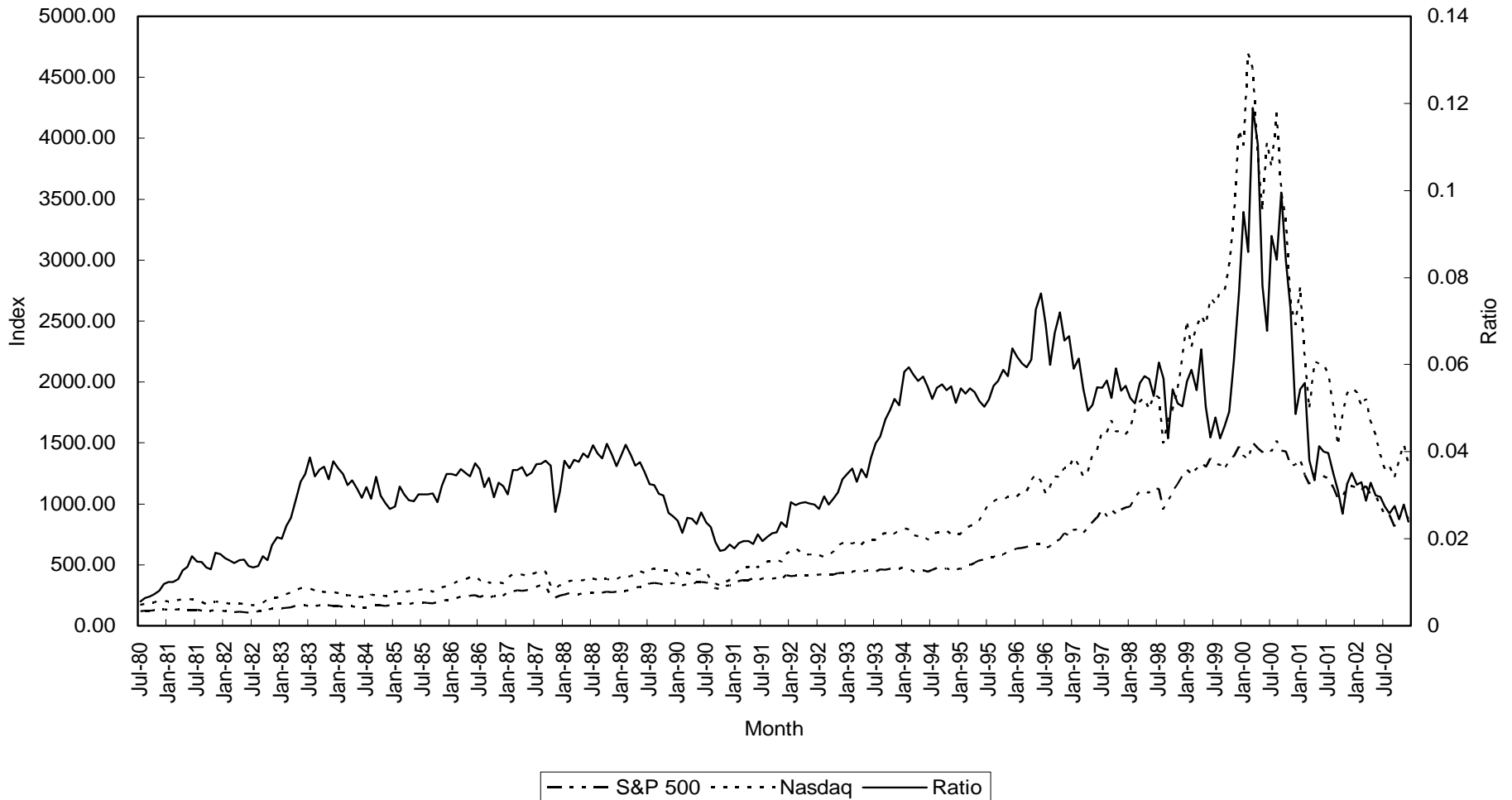
Risk and Return of IPO Portfolios

	<u>Equally Weighted</u>				<u>Value-weighted</u>			
	<u>1-YEAR</u>		<u>3-YEAR</u>		<u>1-YEAR</u>		<u>3-YEAR</u>	
	Mean (%)	St. Dev.	Mean (%)	St. Dev.	Mean (%)	St. Dev.	Mean (%)	St. Dev.
All IPOs	0.91	0.089	0.81	0.086	1.34	0.091	0.96	0.086
Venture backed	1.15	0.107	1.03	0.105	1.27	0.121	0.96	0.114
Non-Venture backed	0.82	0.079	0.73	0.076	1.45	0.077	0.98	0.071
With prestigious underwriters	1.36	0.092	1.06	0.090	1.50	0.092	1.07	0.087
With non-prestigious underwriters	0.17	0.087	0.61	0.080	0.33	0.103	0.43	0.084
IPOs by Industry								
Bank Industry	1.21	0.065	1.46	0.059	1.73	0.110	1.63	0.100
Biotechnology Industry	1.55	0.117	1.71	0.110	1.14	0.124	1.11	0.106
Business Service Industry	2.18	0.119	1.14	0.099	2.07	0.117	0.91	0.096
Computer Industry	1.45	0.124	1.29	0.116	1.70	0.138	1.42	0.128
Equipment Industry	1.02	0.114	1.11	0.106	0.71	0.116	1.26	0.112
Health Care Industry	2.20	0.120	1.71	0.090	2.41	0.117	1.84	0.092
Metal Industry	0.57	0.104	0.97	0.082	0.66	0.109	0.57	0.085
Retailer and Wholesaler Industry	0.38	0.091	0.45	0.081	1.72	0.115	1.09	0.091
Other Industry	0.29	0.074	0.42	0.068	1.22	0.079	0.86	0.064

Distribution of IPOs by Year



Ratio of IPO/Non-IPO Firm Market Value



Empirical Results (I)

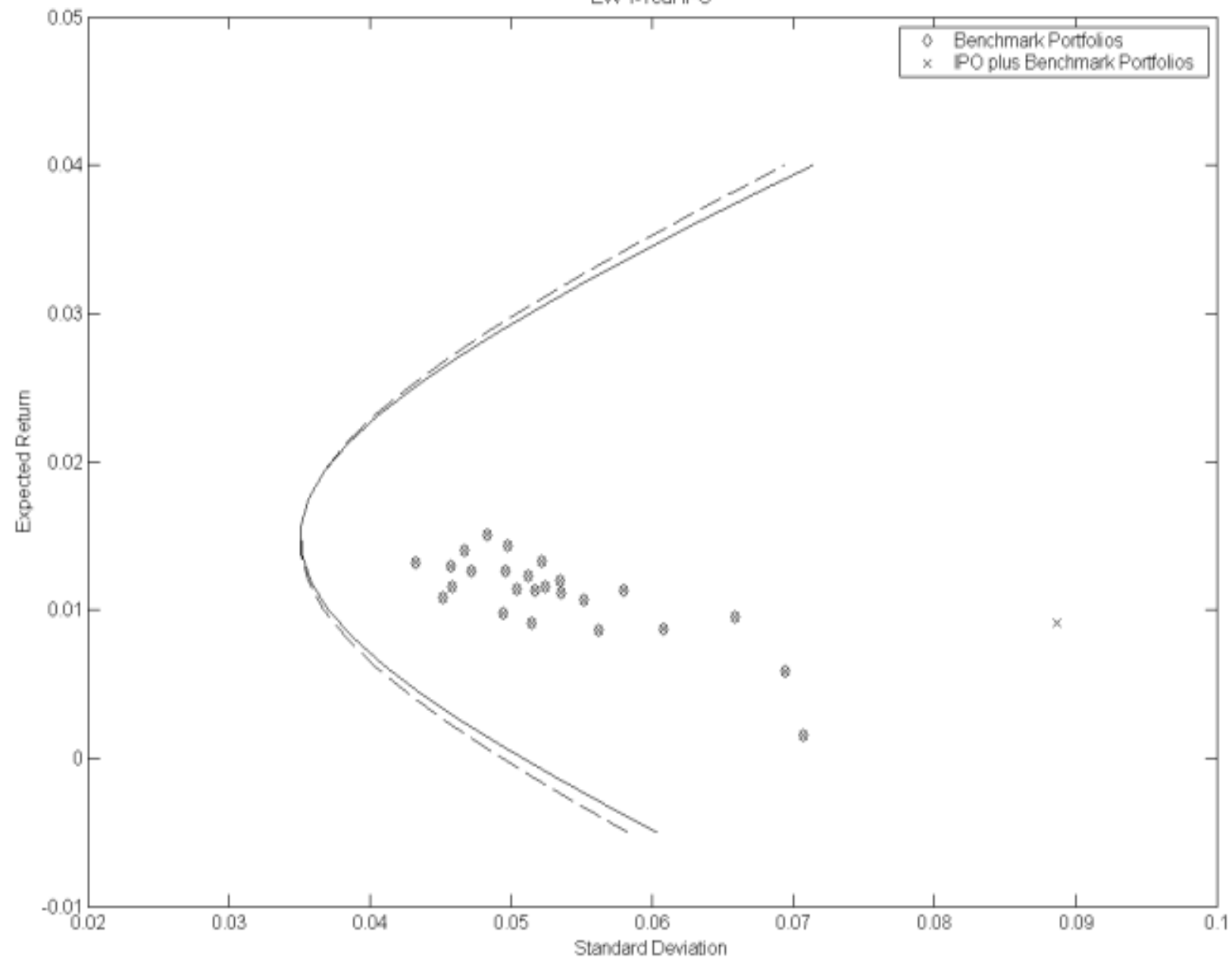
- Equally-weighted 1-year and 3-year IPO portfolios cannot significantly improve the investment opportunity set.
- Value-weighted IPO portfolio can improve the investment opportunity set.
 - 1-year IPO portfolio: the shift due to both tangency and GMV portfolios
 - 3-year IPO portfolio: the shift mainly due to GMV portfolio
- Investing in large IPOs especially within one year after the offering could significantly gain the benefit of diversification

Table 2

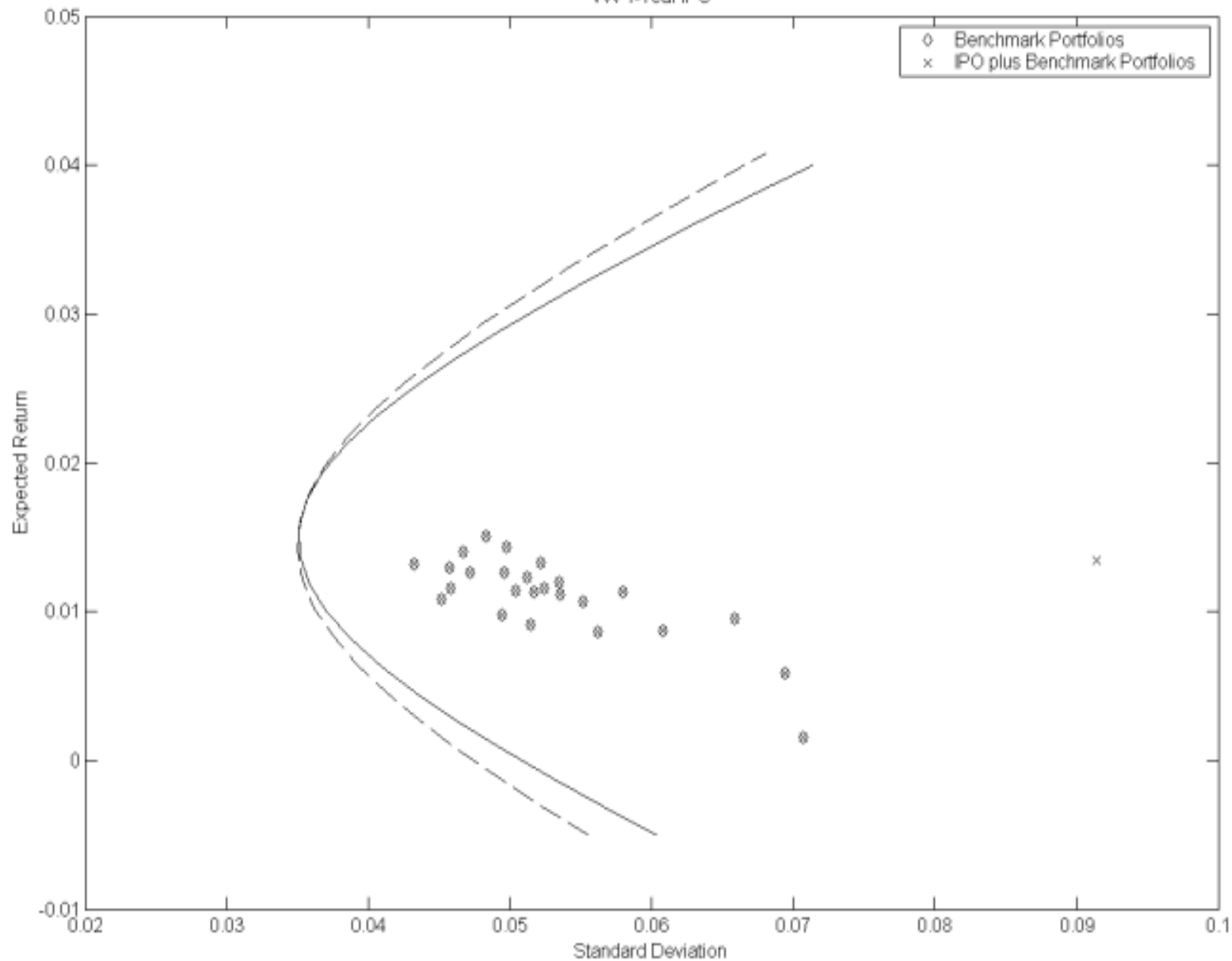
Spanning Tests for All IPOs

	Equally-Weighted				Value-weighted					
	W	Step-Down Tests		W	Step-Down Tests		W	Step-Down Tests		
		W1	W2		W1	W2				
1-YEAR		before	after	Before	after		before	after	before	After
Tangency portfolio return (%)		3.52	3.73				3.52	4.09		
Sharpe ratio		[0.493]	[0.505]				[0.493]	[0.526]		
% change of Sharpe ratio		2.43%					6.69%			
GMV portfolio return (%)				1.48	1.47				1.48	1.44
Sharpe ratio				[0.281]	[0.276]				[0.281]	[0.270]
% change of Sharpe ratio				-1.78%					-3.91%	
Test statistics	4.001	2.363		1.724		10.421	6.335		3.992	
P value	(0.135)	(0.133)		(0.189)		(0.006)**	(0.012)*		(0.046)*	
3-YEAR		before	after	Before	after		before	after	before	After
Tangency portfolio return (%)		3.58	3.83				3.58	4.04		
Sharpe ratio		[0.491]	[0.504]				[0.491]	[0.512]		
% change of Sharpe ratio		2.65%					4.28%			
GMV portfolio return (%)				1.47	1.44				1.47	1.41
Sharpe ratio				[0.276]	[0.268]				[0.276]	[0.260]
% change of Sharpe ratio				-2.90%					-5.80%	
Test statistics	5.110	2.048		3.039		9.992	3.345		6.566	
P value	(0.078)	(0.152)		(0.081)		(0.007)**	(0.067)		(0.010)*	

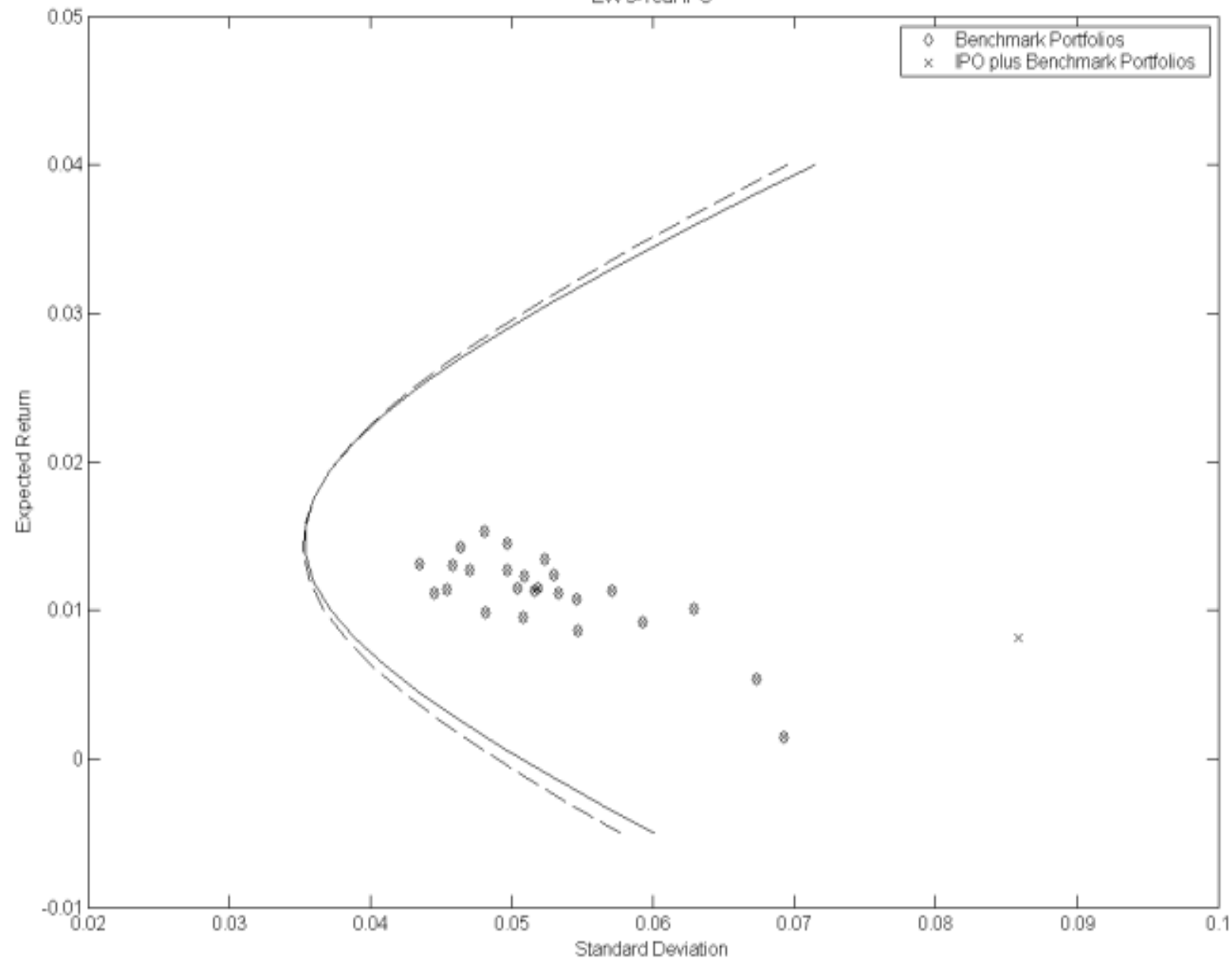
EW 1-Year IPO



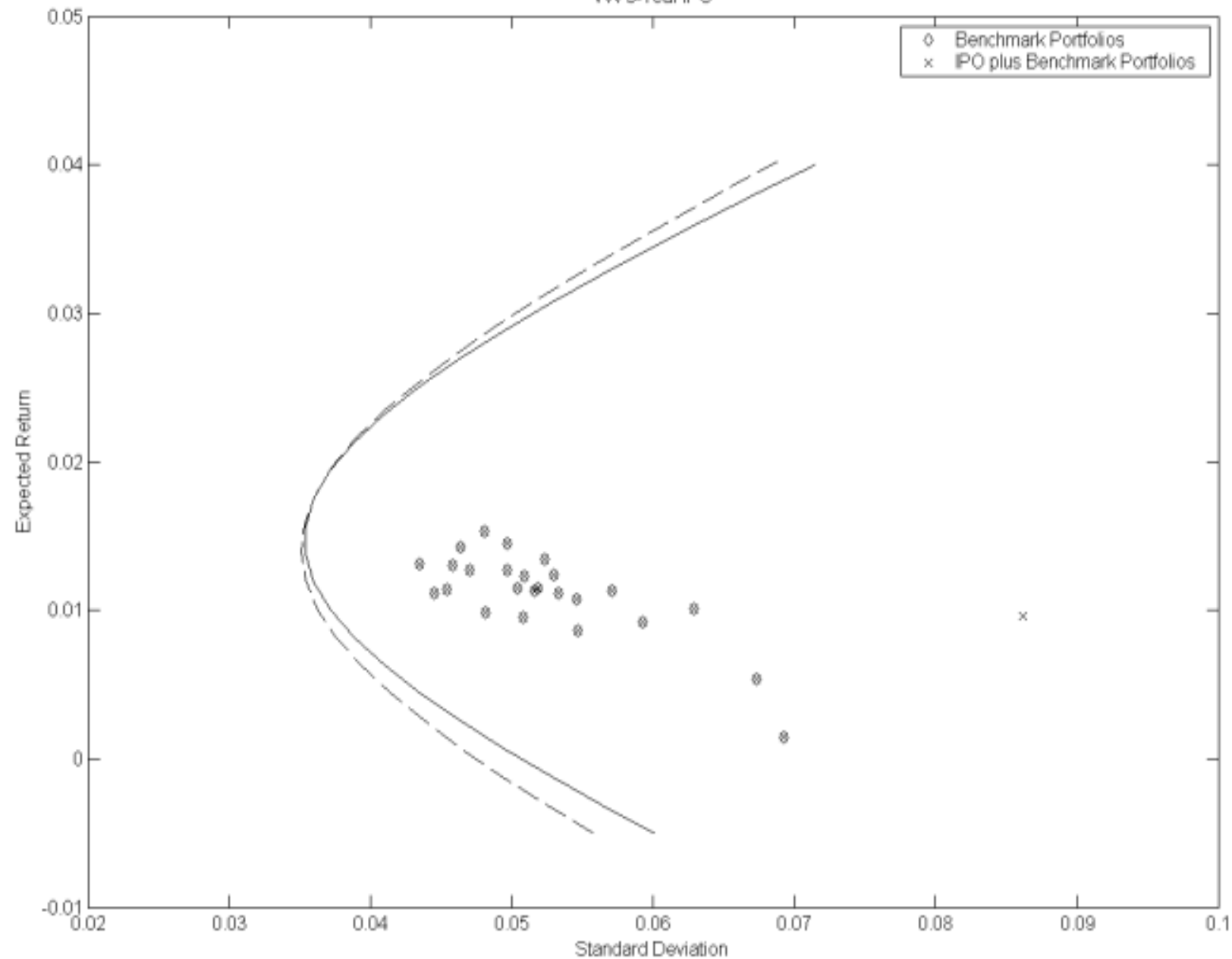
VW 1-Year IPO



EW 3-Year IPO



VW 3-Year IPO



Empirical Results (II)

- Venture backed vs. non-venture backed IPOs
 - Venture backed IPO portfolio: the improvement of investment opportunity set mainly comes from GMV portfolio
 - Non-venture backed IPO portfolio: can only improve the investment opportunity set under value-weighted scheme
- IPOs with or without prestigious underwriters
 - Underwriter reputation has crucial influence on the diversification benefit for IPO stocks
 - IPOs with prestigious underwriters: the improvement of investment opportunity set comes from both tangency and GMV portfolios
 - IPOs without prestigious underwriters: no improvement of investment opportunity set

Panel A of Table 3

Spanning Tests for VC-backed IPOs

	Equally-Weighted				Value-weighted					
	W	Step-Down Tests		W	Step-Down Tests		W	Step-Down Tests		
		W1	W2		W1	W2				
1-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.52	3.88				3.52	3.81		
Sharpe ratio		[0.493]	[0.512]				[0.493]	[0.504]		
% change of Sharpe ratio		3.85%					2.23%			
GMV portfolio return (%)				1.48	1.44				1.48	1.43
Sharpe ratio				[0.281]	[0.270]				[0.281]	[0.267]
% change of Sharpe ratio				-3.91%					-4.98%	
Test statistics	7.376	3.373		3.954		7.946	1.711		6.195	
P value	(0.025)*	(0.066)		(0.047)*		(0.032)*	(0.191)		(0.013)*	
3-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.58	4.19				3.58	3.97		
Sharpe ratio		[0.491]	[0.516]				[0.491]	[0.502]		
% change of Sharpe ratio		5.09%					2.24%			
GMV portfolio return (%)				1.47	1.38				1.47	1.37
Sharpe ratio				[0.276]	[0.252]				[0.276]	[0.252]
% change of Sharpe ratio				-8.70%					-8.70%	
Test statistics	14.018	3.929		9.944		15.696	1.215		14.415	
P value	(0.001)**	(0.048)*		(0.002)**		(0.000)**	(0.270)		(0.000)**	

Panel B of Table 3

Spanning Tests for Non-VC Backed IPOs

	Equally-Weighted				Value-weighted				
	W	Step-Down Tests		W	Step-Down Tests		before	After	
		W1	W2		W1	W2			
1-YEAR		before	after	before	after	before	after	before	After
Tangency portfolio return (%)		3.52	3.62			3.52	4.26		
Sharpe ratio		[0.493]	[0.498]			[0.493]	[0.543]		
% change of Sharpe ratio		1.01%				10.14%			
GMV portfolio return (%)				1.48	1.47			1.48	1.46
Sharpe ratio				[0.281]	[0.279]			[0.281]	[0.275]
% change of Sharpe ratio				-0.71%				-2.14%	
Test statistics	1.990	1.068	0.978	13.388		10.239		2.987	
P value	(0.370)	(0.315)	(0.323)	(0.001)**		(0.001)**		(0.084)	
3-YEAR		before	after	before	after	before	after	before	After
Tangency portfolio return (%)		3.58	3.65			3.58	3.96		
Sharpe ratio		[0.491]	[0.496]			[0.491]	[0.515]		
% change of Sharpe ratio		1.02%				4.89%			
GMV portfolio return (%)				1.47	1.47			1.47	1.45
Sharpe ratio				[0.276]	[0.275]			[0.276]	[0.270]
% change of Sharpe ratio				-0.36%				-2.17%	
Test statistics	1.189	0.849	0.339	6.669		4.388		2.244	
P value	(0.552)	(0.357)	(0.560)	(0.036)*		(0.036)*		(0.134)	

Panel A of Table 4

Spanning Tests for IPOs with Prestigious Underwriters

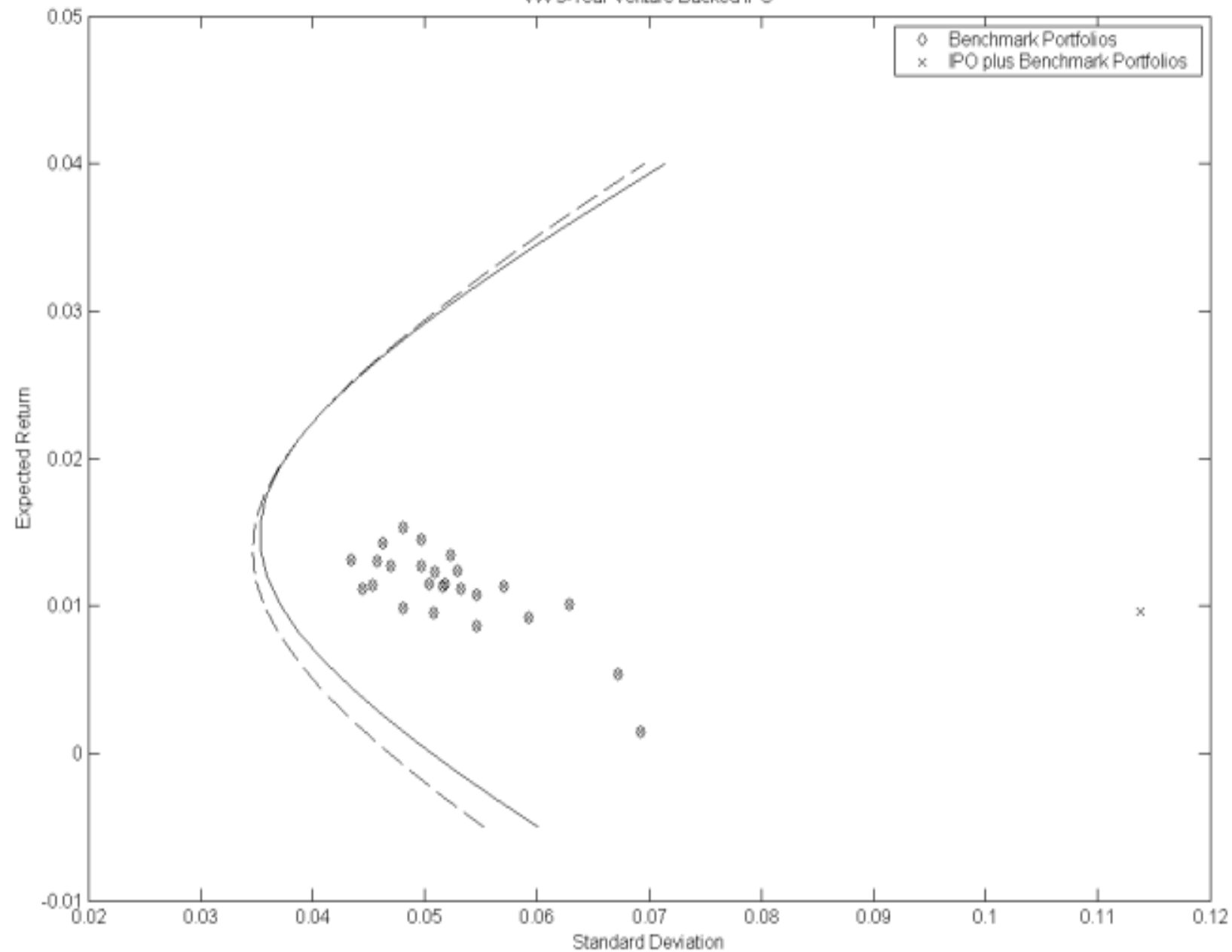
	Equally-Weighted				Value-weighted				
	W	Step-Down Tests		W	Step-Down Tests		W	W	
		W1	W2		W1	W2			
1-YEAR		before	after	before	after	before	after	before	After
Tangency portfolio return (%)		3.52	4.11			3.52	4.14		
Sharpe ratio		[0.493]	[0.528]			[0.493]	[0.533]		
% change of Sharpe ratio		7.10%				8.11%			
GMV portfolio return (%)				1.48	1.44			1.48	1.45
Sharpe ratio				[0.281]	[0.270]			[0.281]	[0.273]
% change of Sharpe ratio				-3.91%				-2.85%	
Test statistics	10.784	6.760		3.925		11.106	7.822		3.191
P value	(0.005)**	(0.009)**		(0.048)*		(0.004)**	(0.005)**		(0.074)
3-YEAR		before	after	before	after	before	after	before	After
Tangency portfolio return (%)		3.58	4.11			3.58	4.14		
Sharpe ratio		[0.491]	[0.515]			[0.491]	[0.517]		
% change of Sharpe ratio		4.89%				5.30%			
GMV portfolio return (%)				1.47	1.40			1.47	1.40
Sharpe ratio				[0.276]	[0.258]			[0.276]	[0.258]
% change of Sharpe ratio				-6.52%				-6.52%	
Test statistics	11.146	3.967		7.075		11.366	4.347		6.908
P value	(0.004)**	(0.046)*		(0.008)**		(0.003)**	(0.037)*		(0.009)**

Panel B of Table 4

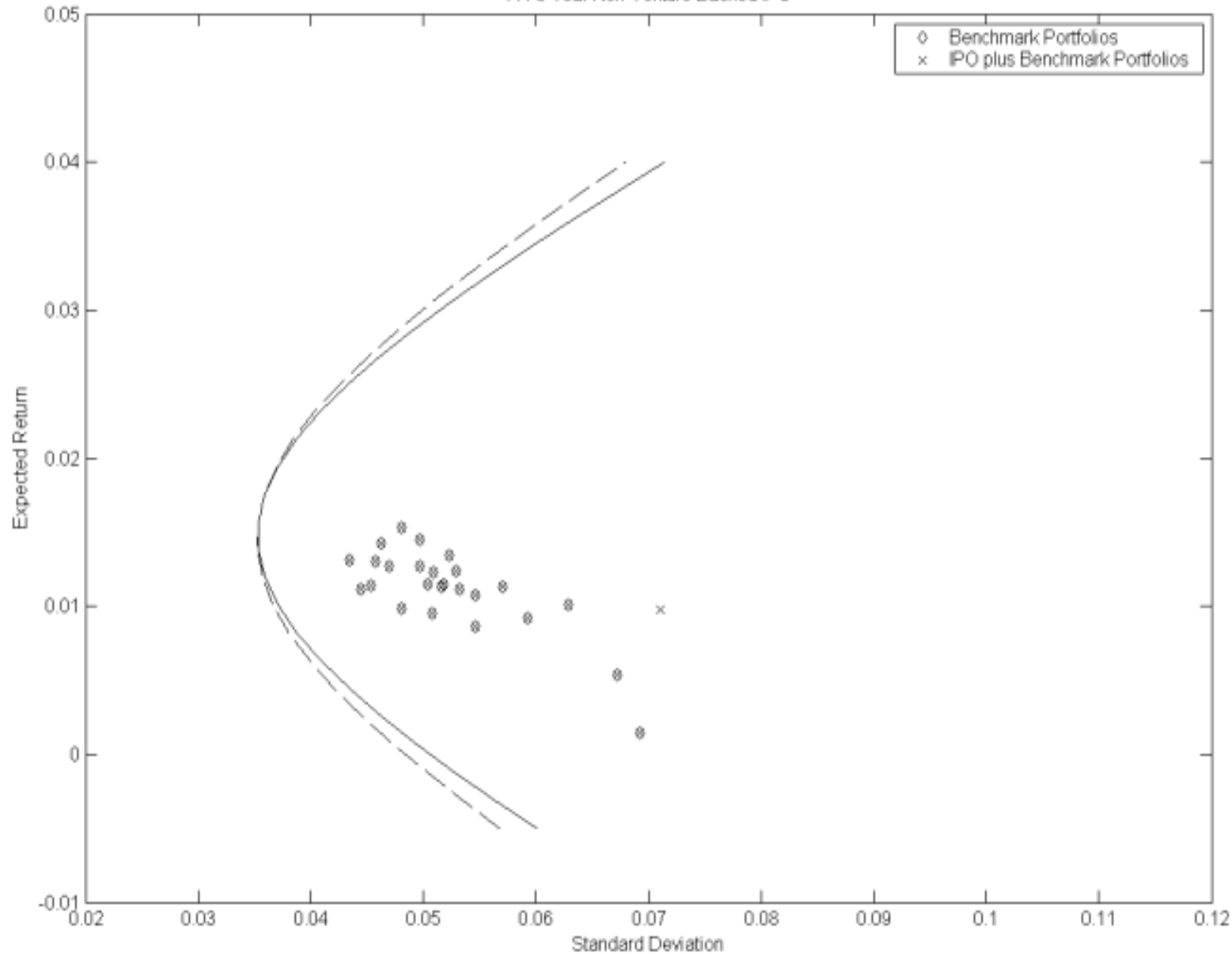
Spanning Tests for IPOs with Non-Prestigious Underwriters

	Equally-Weighted				Value-weighted					
	W	Step-Down Tests		W	Step-Down Tests		W	Step-Down Tests		
		W1	W2		W1	W2				
1-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.52	3.56				3.52	3.53		
Sharpe ratio		[0.493]	[0.495]				[0.493]	[0.493]		
% change of Sharpe ratio		0.41%					0.00%			
GMV portfolio return (%)				1.48	1.48				1.48	1.48
Sharpe ratio				[0.281]	[0.281]				[0.281]	[0.280]
% change of Sharpe ratio				0.00%					-0.36%	
Test statistics	0.705	0.546		0.159		0.696	0.007		0.690	
P value	(0.703)	(0.460)		(0.690)		(0.706)	(0.935)		(0.406)	
3-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.58	3.60				3.58	3.57		
Sharpe ratio		[0.491]	[0.493]				[0.491]	[0.491]		
% change of Sharpe ratio		0.41%					0.00%			
GMV portfolio return (%)				1.47	1.47				1.47	1.47
Sharpe ratio				[0.276]	[0.276]				[0.276]	[0.276]
% change of Sharpe ratio				0.00%					0.00%	
Test statistics	0.427	0.394		0.033		3.489	0.135		3.353	
P value	(0.821)	(0.530)		(0.856)		(0.175)	(0.714)		(0.067)	

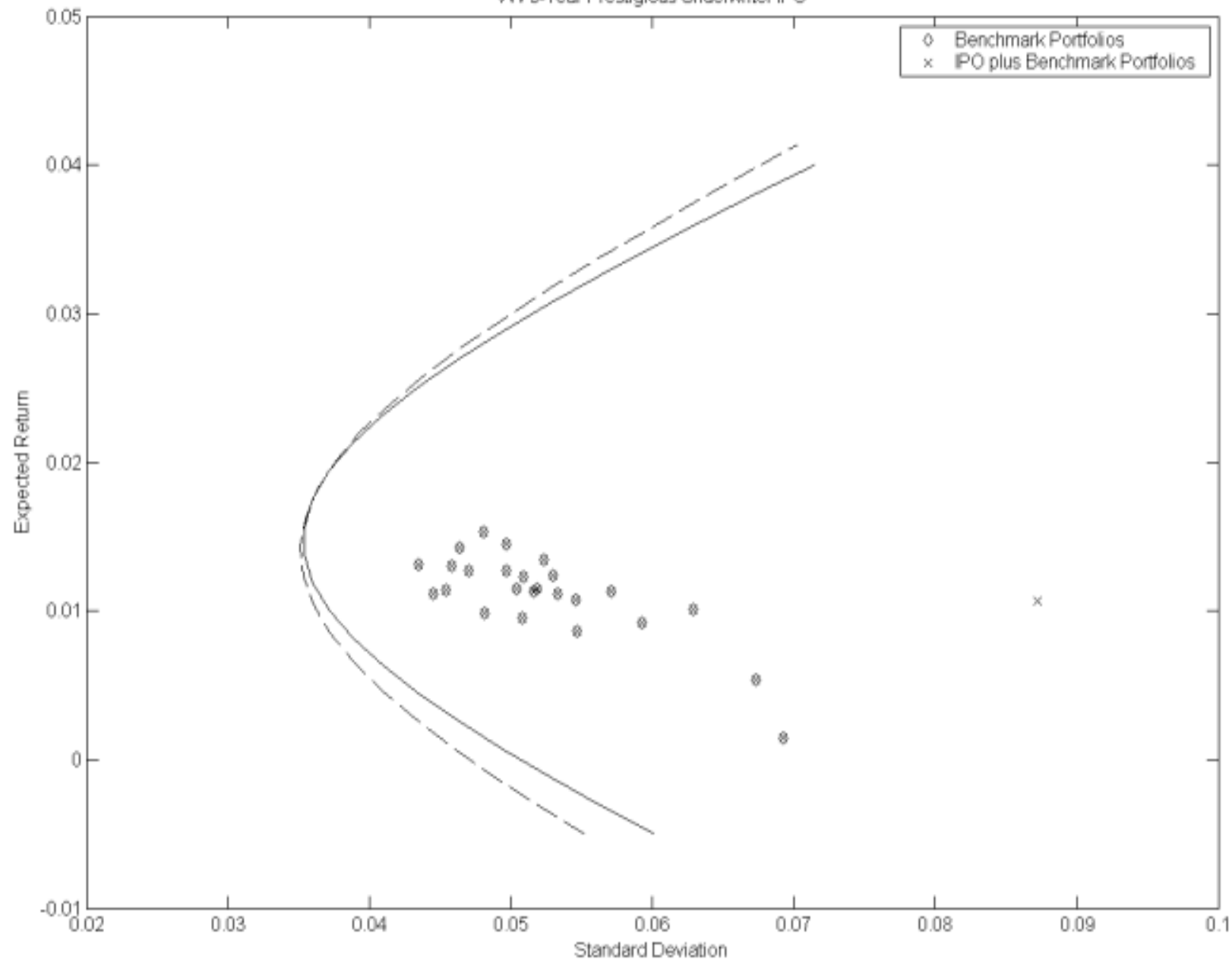
VW 3-Year Venture Backed IPO



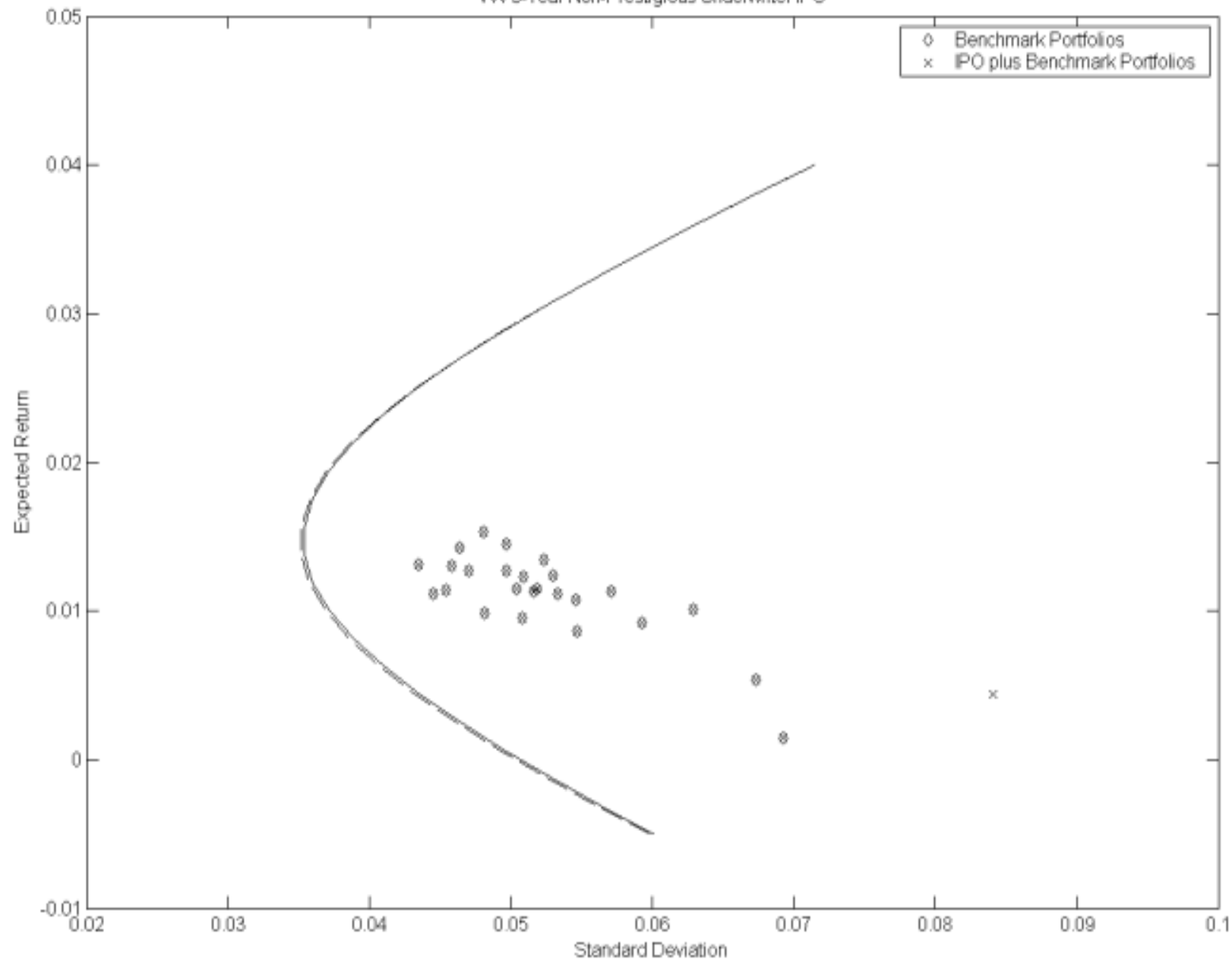
VW 3-Year Non-Venture Backed IPO



VW 3-Year Prestigious Underwriter IPO



VW 3-Year Non-Prestigious Underwriter IPO



Empirical Results (III)

- 3 out of 9 industry portfolios significantly improve the investment opportunity set
 - Business services: the shift due to both tangency and GMV portfolios
 - Computer: the shift due to both tangency and GMV portfolios
 - Health care: the shift mainly due to GMV portfolio
- Robustness check for the period of 1980-1998
 - Internet bubble only has minor influence to our empirical findings.

Panel A of Table 5

Spanning Tests for IPOs in the Business Services Industry

	Equally-Weighted				Value-weighted					
	W	Step-Down Tests		W	Step-Down Tests		W	Step-Down Tests		
		W1	W2		W1	W2				
1-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.52	4.59				3.52	4.28		
Sharpe ratio		[0.493]	[0.559]				[0.493]	[0.538]		
% change of Sharpe ratio		13.39%					9.13%			
GMV portfolio return (%)				1.48	1.43				1.48	1.43
Sharpe ratio				[0.281]	[0.267]				[0.281]	[0.268]
% change of Sharpe ratio				-4.98%					-4.63%	
Test statistics	18.867	13.277		5.328		13.738	8.701		4.879	
P value	(0.000)**	(0.000)**		(0.021)*		(0.001)**	(0.003)**		(0.021)*	
3-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.58	4.24				3.58	3.67		
Sharpe ratio		[0.491]	[0.521]				[0.491]	[0.493]		
% change of Sharpe ratio		6.11%					0.41%			
GMV portfolio return (%)				1.47	1.39				1.47	1.43
Sharpe ratio				[0.276]	[0.254]				[0.276]	[0.266]
% change of Sharpe ratio				-7.97%					-3.62%	
Test statistics	13.492	4.958		8.381		9.014	0.044		8.968	
P value	(0.001)**	(0.026)*		(0.004)**		(0.011)*	(0.834)		(0.003)**	

Panel B of Table 5

Spanning Tests for IPOs in the Computer Industry

	Equally-Weighted				Value-weighted					
	W	Step-Down Tests		W	Step-Down Tests		W	Step-Down Tests		
		W1	W2		W1	W2				
1-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.52	4.08				3.52	4.02		
Sharpe ratio		[0.493]	[0.523]				[0.493]	[0.519]		
% change of Sharpe ratio		6.09%					5.27%			
GMV portfolio return (%)				1.48	1.43				1.48	1.43
Sharpe ratio				[0.281]	[0.267]				[0.281]	[0.267]
% change of Sharpe ratio				-4.98%					-4.98%	
Test statistics	10.780	5.474		5.200		9.921	4.581		5.252	
P value	(0.005)**	(0.019)*		(0.023)*		(0.007)**	(0.032)*		(0.022)*	
3-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.58	4.47				3.58	4.27		
Sharpe ratio		[0.491]	[0.533]				[0.491]	[0.519]		
% change of Sharpe ratio		8.55%					5.70%			
GMV portfolio return (%)				1.47	1.38				1.47	1.37
Sharpe ratio				[0.276]	[0.251]				[0.276]	[0.249]
% change of Sharpe ratio				-9.06%					-9.78%	
Test statistics	16.837	7.320		9.266		15.716	4.355		11.180	
P value	(0.000)**	(0.007)**		(0.002)**		(0.000)**	(0.037)*		(0.001)**	

Panel C of Table 5

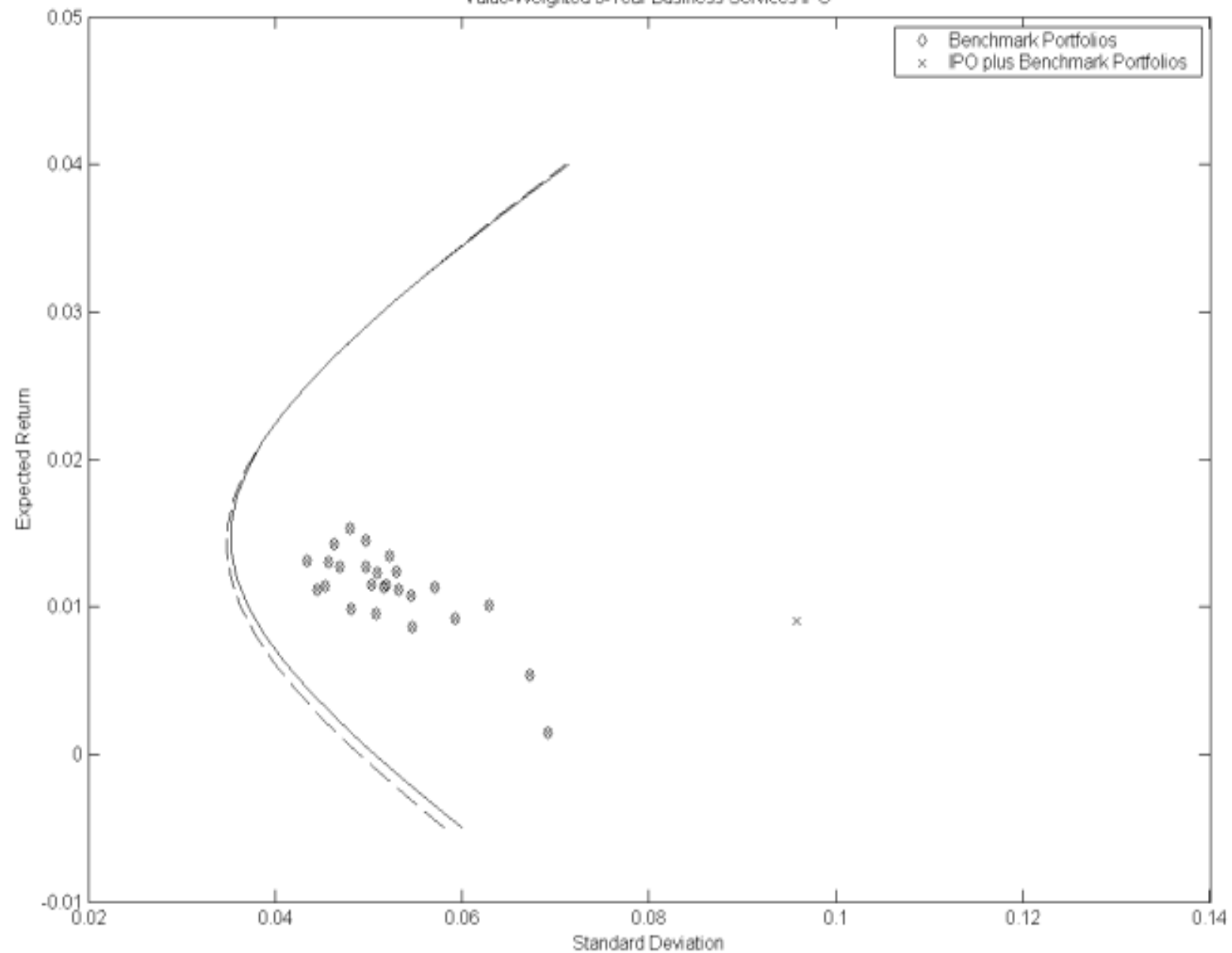
Spanning Tests for IPOs in the Health Care Industry

	Equally-Weighted				Value-weighted					
	W	Step-Down Tests		W	Step-Down Tests		W	Step-Down Tests		
		W1	W2		W1	W2				
1-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.52	3.91				3.52	3.81		
Sharpe ratio		[0.493]	[0.509]				[0.493]	[0.502]		
% change of Sharpe ratio		3.25%					1.83%			
GMV portfolio return (%)				1.48	1.42				1.48	1.41
Sharpe ratio				[0.281]	[0.265]				[0.281]	[0.264]
% change of Sharpe ratio				-5.69%					-6.05%	
Test statistics	9.439	2.629		6.744		10.586	1.155		9.391	
P value	(0.009)**	(0.105)		(0.009)**		(0.005)**	(0.283)		(0.002)**	
3-YEAR		before	after	before	after		before	after	before	After
Tangency portfolio return (%)		3.58	3.86				3.58	3.74		
Sharpe ratio		[0.491]	[0.501]				[0.491]	[0.495]		
% change of Sharpe ratio		2.04%					0.81%			
GMV portfolio return (%)				1.47	1.42				1.47	1.42
Sharpe ratio				[0.276]	[0.262]				[0.276]	[0.264]
% change of Sharpe ratio				-5.07%					-4.35%	
Test statistics	8.305	1.362		6.908		9.058	0.290		8.759	
P value	(0.016)*	(0.243)		(0.009)**		(0.011)*	(0.591)		(0.003)**	

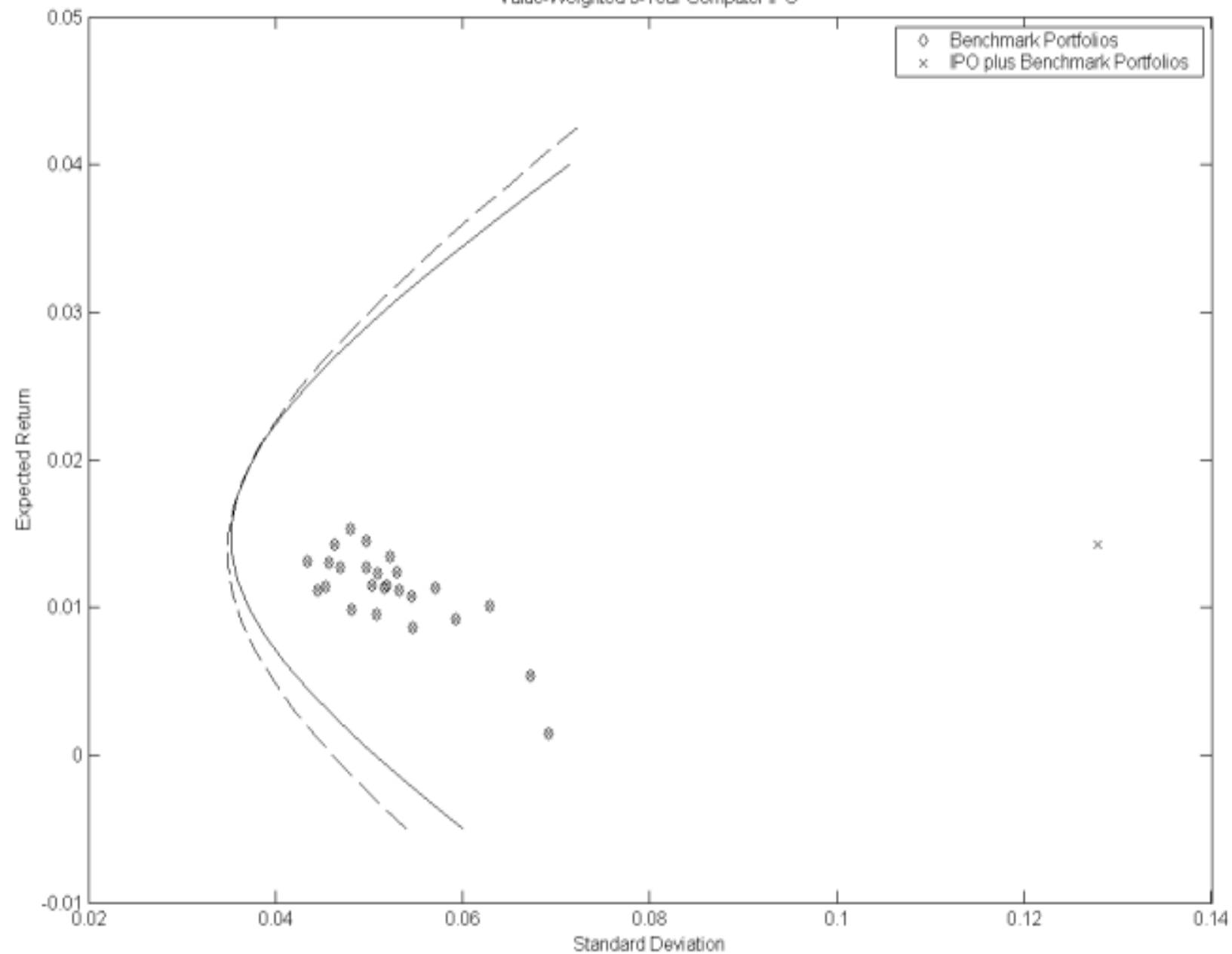
Table 6
Summary and Robustness Check

	1980-2002				1980-1998			
	1-YEAR		3-YEAR		1-YEAR		3-YEAR	
	EW	VW	EW	VW	EW	VW	EW	VW
All IPOs		X		X	X	X	X	X
VC-back	X	X	X	X	X	X	X	X
Non VC-back		X		X	X	X		X
Prestigious Underwriters	X	X	X	X	X	X	X	X
Non-prestigious Underwriters						X		X
IPOs by Industries								
Banking		X		X		X	X	X
Biotechnology			X				X	X
Business services	X	X	X	X	X	X	X	X
Health care	X	X	X	X	X	X	X	X
Equipment			X	X	X			X
Computer	X	X	X	X	X	X	X	X
Metal			X	X				
Retailer and wholesaler		X		X		X		X
Other						X		

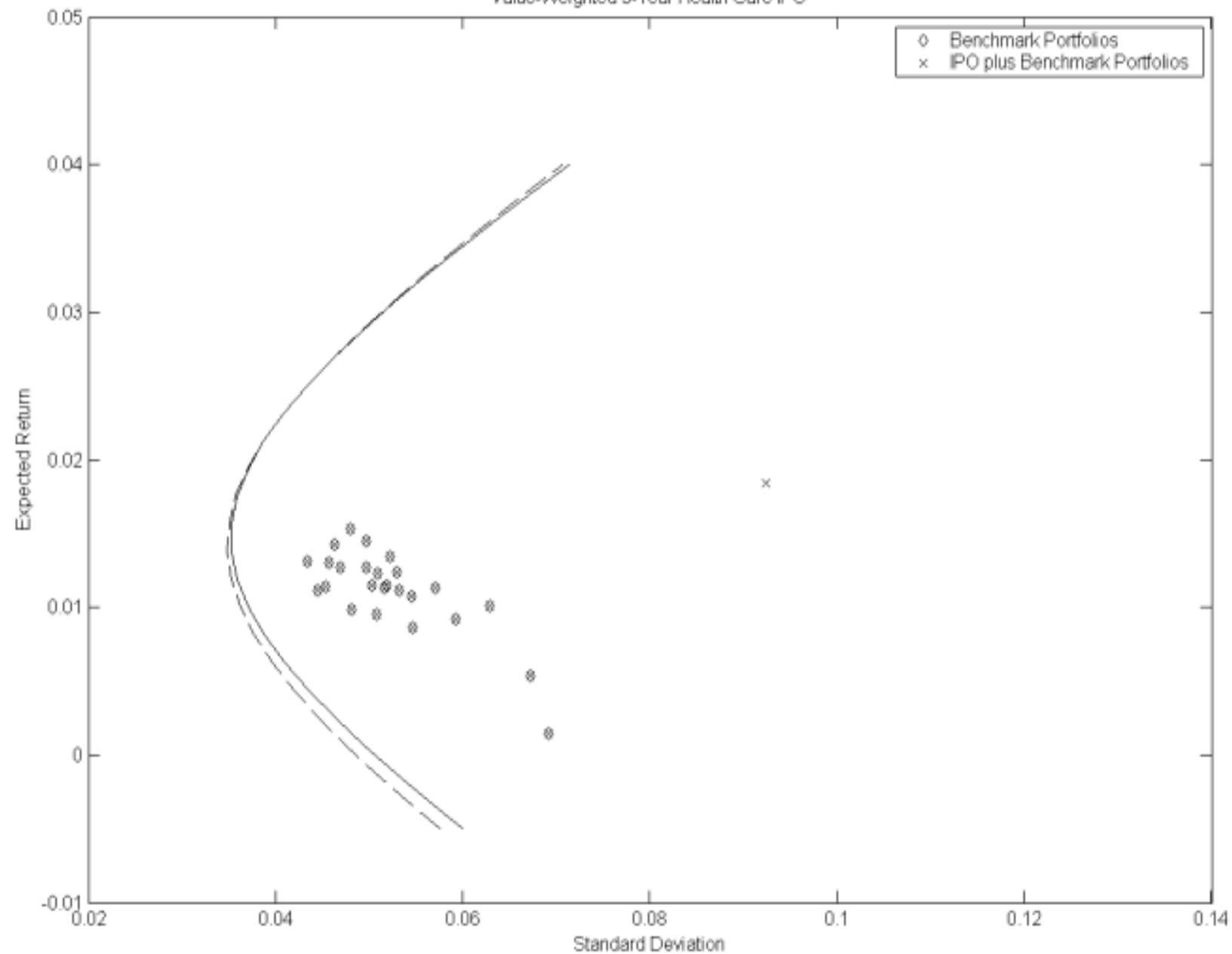
Value-Weighted 3-Year Business Services IPO



Value-Weighted 3-Year Computer IPO



Value-Weighted 3-Year Health Care IPO



Conclusion

- The market value of IPOs is small relative to the equity market
 - The average ratio of market value of the value-weighted 3-year IPO portfolio to non-IPO firms is only around 4%.
- Still, adding an IPO portfolio does lead to a statistically and economically significant enlargement of the investment opportunity set for mean-variance investors relative to investing in a set of benchmark portfolios.
 - Value-weighted IPO portfolios
 - Venture backed IPOs
 - IPOs with prestigious underwriters
 - Business services, computer and health care IPOs

Future Research

- Consider factors like short sale constraints and bid-ask spreads that may be relevant for investors holding IPO stocks.
- Use other decontaminated benchmark portfolios
 - Industry portfolios
 - Portfolios formed on dividend yield or the price-earning ratio

Some thoughts about why IPOs can gain diversification benefit:

- New industry effect
- Or incomplete spanning (Mauer and Senbet 1992)