STYLE INVESTING

WITH

UNCERTAINTY

Deniz KEBABCI

(San Francisco State University)

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Outline

- Introduction
- Contributions of the Paper
- Literature Review
- Methodology and Data
- Empirical Results
- Conclusion

Introduction

This paper:

- analyzes the predictability of different style portfolio returns.
- looks at style momentum and macro variables as predictor variables.
- uses a time-varying parameter model to take into account the effect of learning.

Style Portfolios

SMB=1/3*(Small Value + Small Neutral + Small Growth) - 1/3*(Big Value + Big Neutral + Big Growth)

HML=1/2*(Small Value + Big Value) - 1/2*(Small Growth + Big Growth)

Mom=1/2*(Small High + Big High) – 1/2*(Small Low + Big Low)

Contributions of the Paper

- Style investing
- Using macroeconomic variables
- Taking into account the effect of learning
- Comparisons with the linear model

Literature Review

- Barberis and Shleifer (2003) on style investing.
- Adrian and Franzoni (2005) on learning.
- Chen, Roll and Ross (1986) on macroeconomic variables.
- Flannery and Protopapadakis (2002) using GARCH.
- McQueen and Roley (1993) and Boyd, Jagannathan, and Hu (2001) on time-varying effects.
- Pesaran and Timmermann (2002) on structural change points.
- Hahn and Lee (2003), Vassalou (2003), Petkova (2006) on underlying risks behind FF Factors.

Methodology

1) Linear Single Factor Model:

$$r_{it} = \alpha_{0i} + \alpha_{1i} f_{t-1} + \varepsilon_{it}$$

2) Linear Model with Multiple Factors:

$$r_{it} = \alpha_{0i} + \sum_{k=1}^{K} \alpha_{1ik} f_{kt-1} + \varepsilon_{it}$$

3) TVP Single Factor Model with Changing Conditional Variance:

$$r_{it} = \alpha_{0it} + \alpha_{1it} f_{t-1} + \varepsilon_{it}$$

$$\alpha_{jit+1} = \alpha_{jit} + u_{jit}$$

4) TVP Multifactor Model with Changing Conditional Variance:

$$r_{it} = \alpha_{0it} + \sum_{k=1}^{K} \alpha_{1ikt} f_{kt-1} + \varepsilon_{it}$$

$$\alpha_{0it+1} = \alpha_{0it} + u_{0it}$$

$$\alpha_{1ikt+1} = \alpha_{1ikt} + u_{1ikt}$$

- Faff, et al (2000) conclude Kalman Filter approaches dominate ARCH.

- Sunder (1980), Simonds, et al (1986) random walk specification better. These papers are restricted to the behavior of systematic risk of individual stock returns.

- It’s more reasonable to assume that any shock to a style portfolio’s coefficients persist indefinitely into the future (random walk) then assuming stationarity of the coefficients (AR, ARMA) or assuming any shock in any one period has no effect on future coefficient values (random coefficients specification).

Data

- Style portfolios from French's website.
- Macro variables from CRSP, Datastream, FACTSET.
- Short-term momentum (6 month price momentum), long-term momentum (24 month price momentum).
- Time period: 1974/12-2003/12 and 1992/3-2003/12.
- Frequency: Monthly.

Estimation Results with Linear Single Factor Model

Dependent Variable		Independent Variable		
Portfolio Returns		Macroeconomic Variable		
Intercept	T-stat		Coefficient	T-stat
1974/12-2003/12				
SMB				
0.321	1.147	Monthly Growth of Inf	1.552	0.011
-0.180	-0.548	Annual Growth of Inf	25.357	1.812
0.535	1.322	1 month T-bill Rate	-41.217	-0.582
0.304	1.716	Term Structure	8.214	1.117
0.455	2.480	Monthly Growth of IP	-61.835	-2.469
0.552	2.778	Annual Growth of IP	-9.654	-2.457
HML				
0.363	1.357	Monthly Growth of Inf	34.495	0.265
0.521	1.648	Annual Growth of Inf	-5.189	-0.386
0.225	0.581	1 month T-bill Rate	37.614	0.555
0.397	2.340	Term Structure	9.315	1.324
0.420	2.373	Monthly Growth of IP	-0.893	-0.037
0.322	1.683	Annual Growth of IP	4.058	1.071
Mom				
0.618	1.694	Monthly Growth of Inf	138.672	0.783
0.805	1.866	Annual Growth of Inf	1.713	0.093
0.882	1.669	1 month T-bill Rate	-8.343	-0.090
0.874	3.781	Term Structure	-15.568	-1.625
0.710	2.955	Monthly Growth of IP	60.439	1.841
0.854	3.267	Annual Growth of IP	-0.655	-0.127
1992/3-2003/12				
SMB				
-1.156	-0.919	RP1	1.858	1.120
-1.878	-1.210	RP2	2.188	1.372
HML				
0.121	0.103	RP1	0.433	0.279
0.383	0.263	RP2	0.057	0.038
Mom				
2.100	1.271	RP1	-1.577	-0.724
1.878	0.919	RP2	-0.979	-0.466

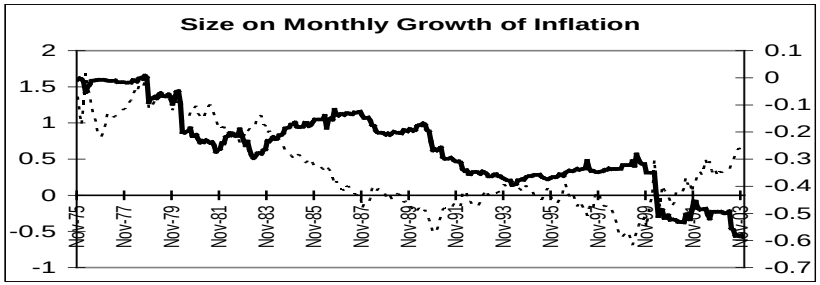
Estimation Results with Linear Single Factor Model

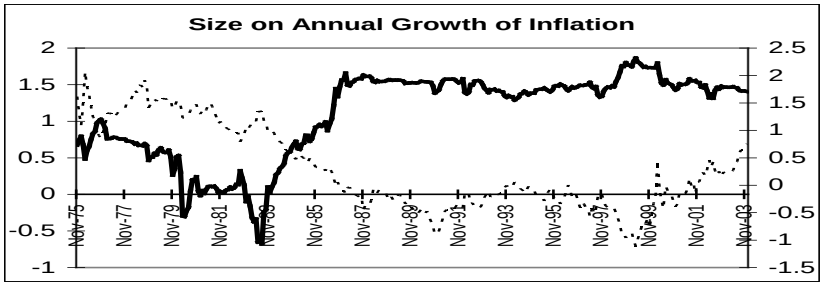
Dependent Variable			Independent Variable		
Portfolio Returns			Momentum Factor		
	Intercept	T-stat		Beta	T-stat
1976/12-2003/12					
SMB					
	-0.010	-0.060	STM	17.239	8.288
	-0.002	-0.011	LTM	4.525	4.557
HML					
	0.024	0.148	STM	15.105	8.920
	0.154	0.789	LTM	2.075	2.482
Mom					
	0.046	0.179	STM	15.500	7.382
	-0.206	-0.491	LTM	4.634	3.281

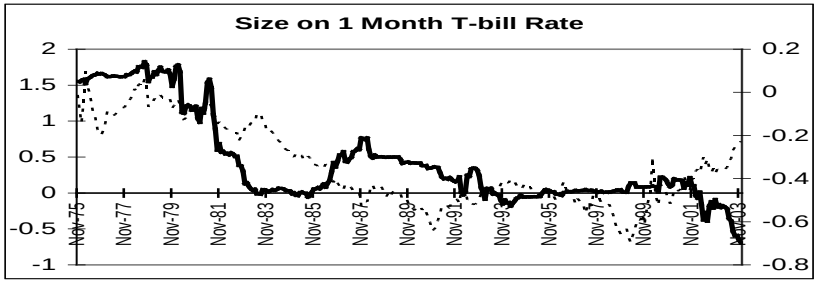
Estimation Results with Linear Multifactor Models

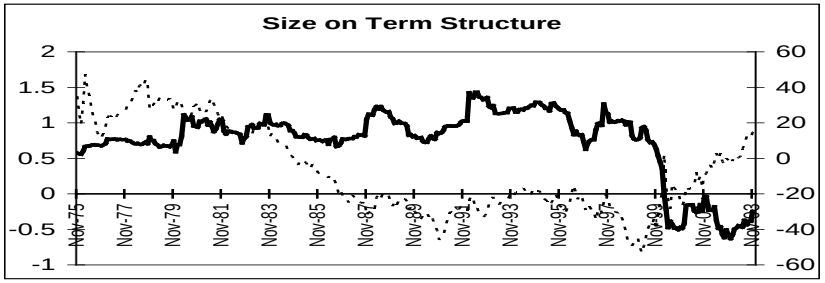
1992/3-2003/12									
Independent Variables	Dependent Variables and Specifications								
	SMB-1	SMB-2	SMB-3	HML-1	HML-2	HML-3	Mom-1	Mom-2	Mom-3
Intercept	-1.71	-0.79	0.74	1.39	-4.45	-4.02	0.40	1.66	3.19
T-stats	-0.78	-0.21	0.18	0.62	-1.08	-1.05	0.14	0.32	0.58
Monthly Growth of Inf	-537.89			463.25			269.75		
T-stats	-1.19			1.10			0.43		
Annual Growth of Inf		-189.01	33.83		226.00	325.44		-67.91	-111.67
T-stats		-1.25	0.24		1.52	2.47		-0.34	-0.59
1 month T-bill Rate	514.64	784.80	-32.29	-221.52	-29.83	62.97	-140.85	-44.46	131.65
T-stats	1.47	1.79	-0.08	-0.62	-0.07	0.17	-0.34	-0.09	0.24
Term Structure	-17.01	-15.44	-25.75	-8.88	-11.70	4.05	-37.83	-38.21	-24.84
T-stats	-1.06	-0.97	-1.51	-0.59	-0.79	0.26	-1.72	-1.76	-1.09
Monthly Growth of IP	-50.27			7.85			16.17		
T-stats	-0.72			0.12			0.17		
Annual Growth of IP		-4.42	-23.50		16.17	-9.26		-6.62	-3.54
T-stats		-0.30	-1.56		1.16	-0.66		-0.35	-0.18
Risk Premium-1	0.79			-1.42			-0.69		
T-stats	0.43			-0.82			-0.26		
Risk Premium-2		0.31	0.04		1.55	1.05		-0.93	-1.34
T-stats		0.13	0.01		0.69	0.43		-0.28	-0.38
Short-Term Momentum	18.99	17.77		16.64	14.40		14.34	14.37	
T-stats	4.35	4.10		5.36	4.19		3.11	3.07	
Long-Term Momentum	3.50	5.92		-0.80	1.09		1.95	2.07	
T-stats	1.15	1.71		-0.46	0.53		0.53	0.56	
R-squared	0.21	0.21	0.05	0.22	0.22	0.06	0.15	0.14	0.01

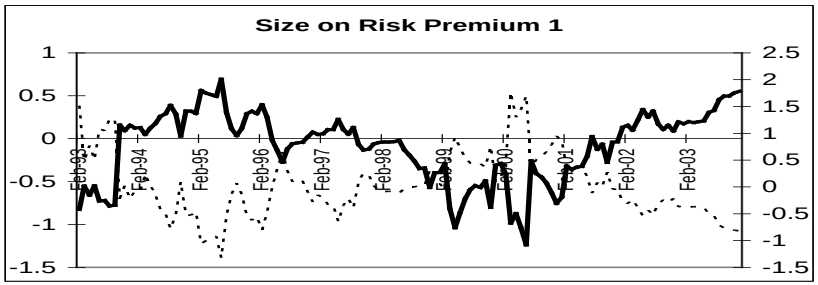
TVP Model with a Single Factor (Size on Macro Variables)

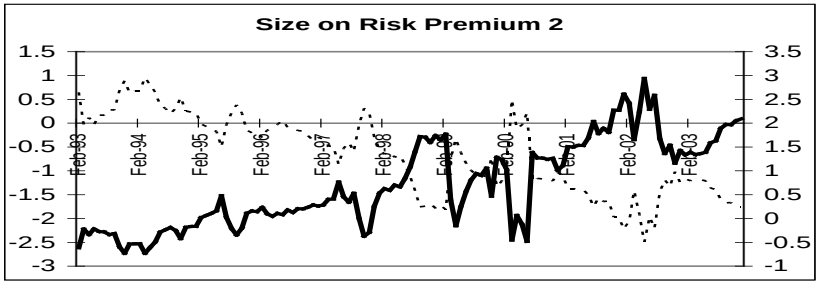


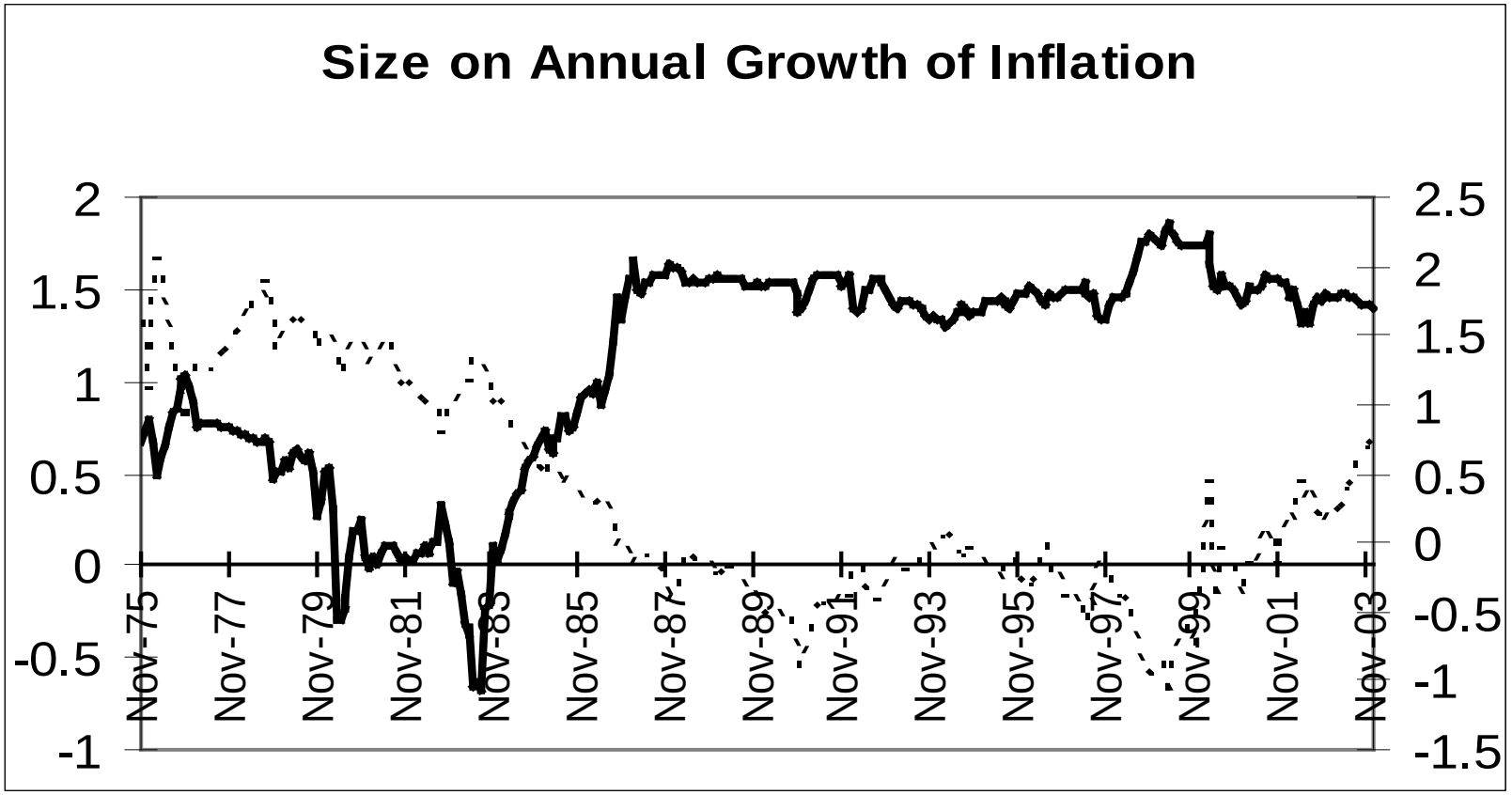




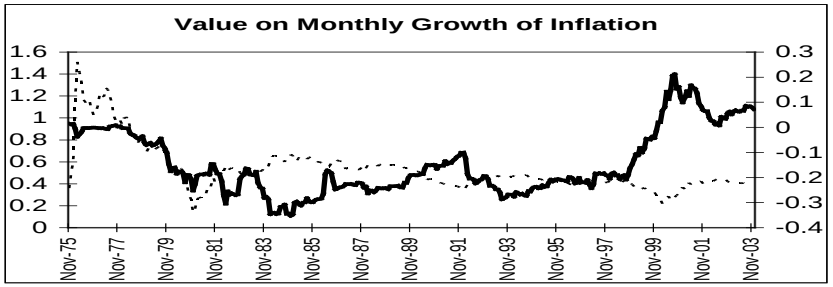


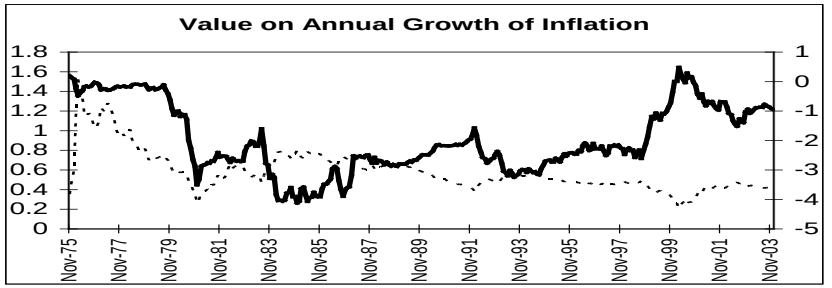


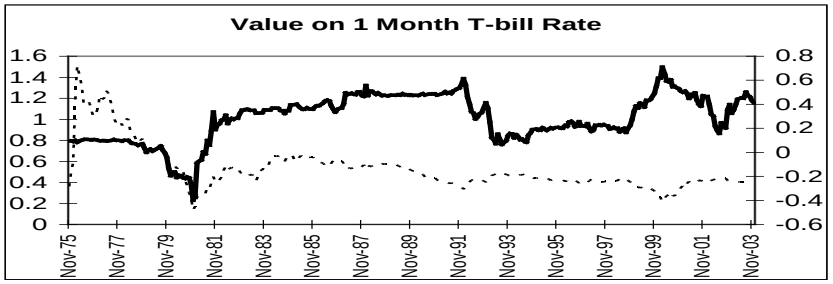


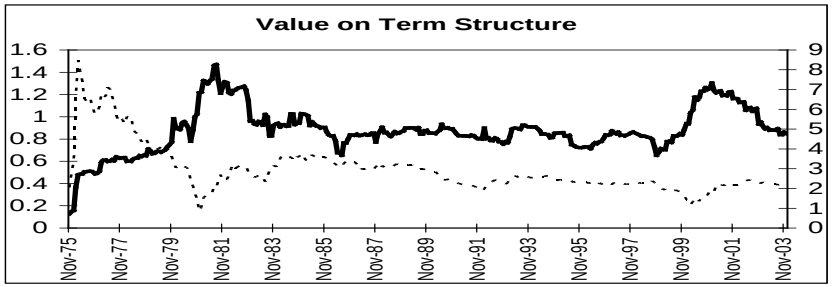

Size on Annual Growth of Inflation
2
1.5
1
0.5
0
-0.5
-1
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
Nov-75
Nov-77
Nov-79
Nov-81
Nov-83
Nov-85
Nov-87
Nov-89
Nov-91
Nov-93
Nov-95
Nov-97
Nov-99
Nov-01
Nov-03

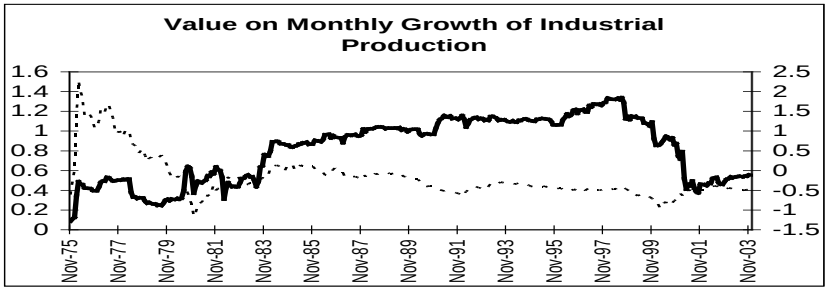
TVP Model with a Single Factor (Value on Macro Variables)

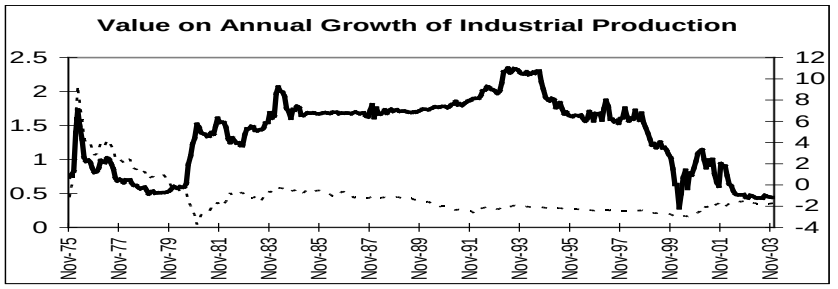


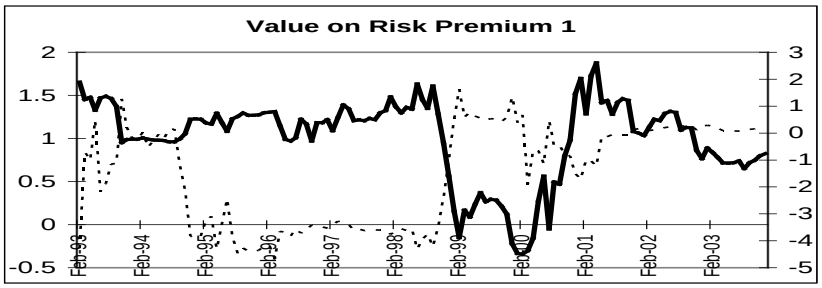


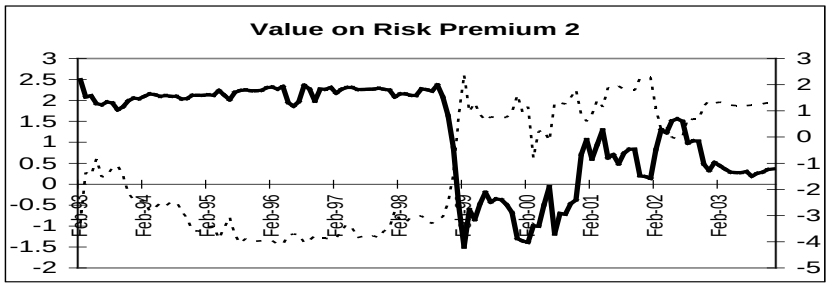


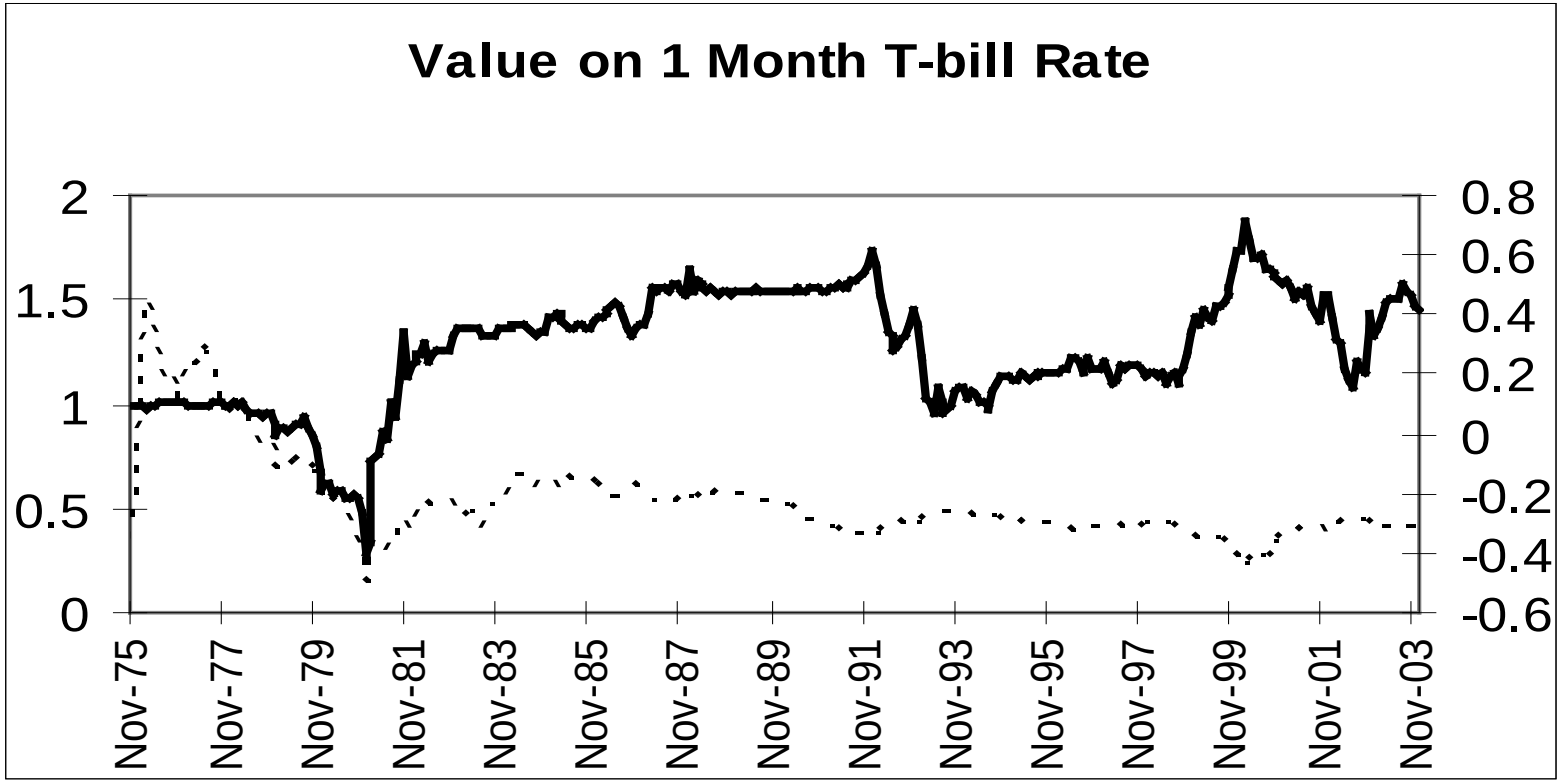




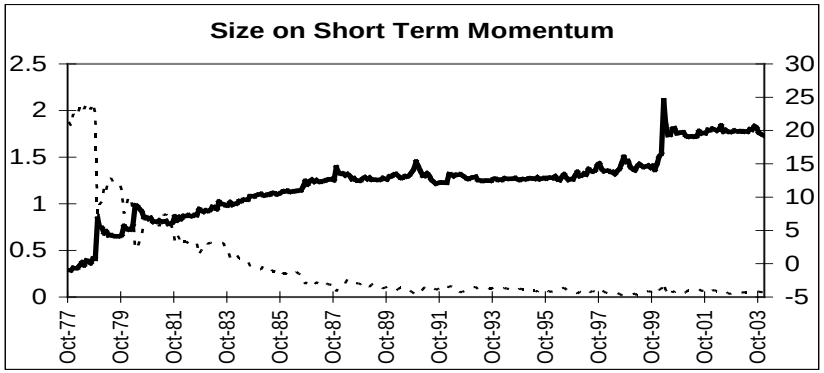


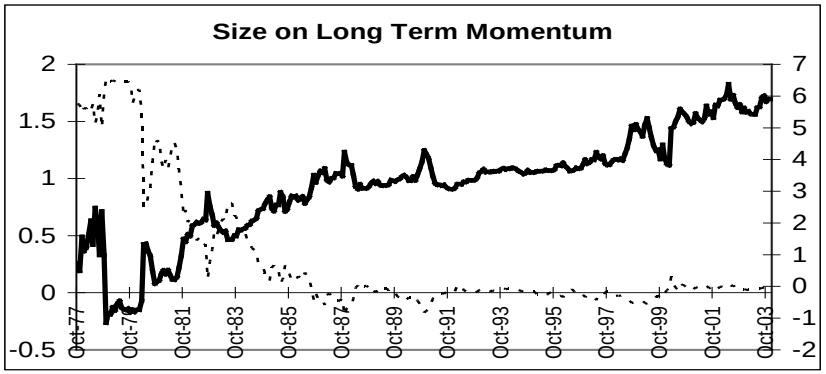


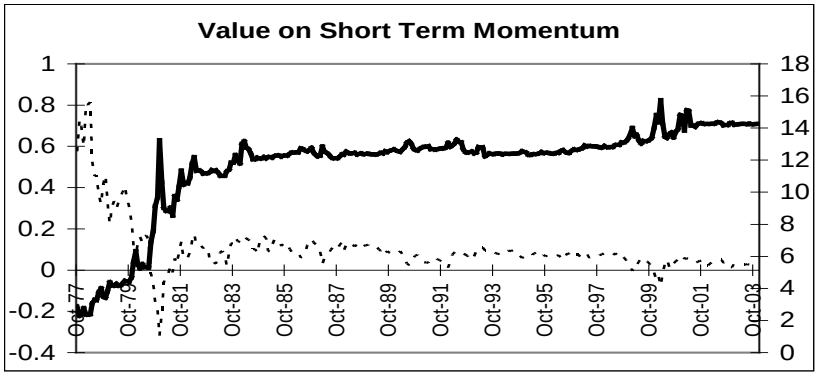


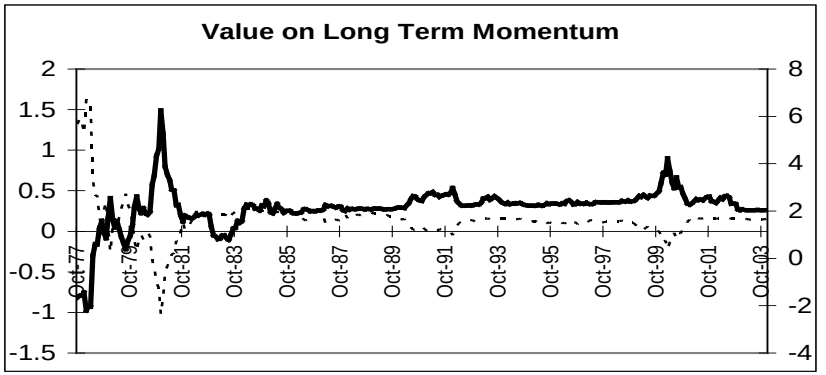

Value on 1 Month T-bill Rate
2
1.5
1
0.5
0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Nov-75
Nov-77
Nov-79
Nov-81
Nov-83
Nov-85
Nov-87
Nov-89
Nov-91
Nov-93
Nov-95
Nov-97
Nov-99
Nov-01
Nov-03

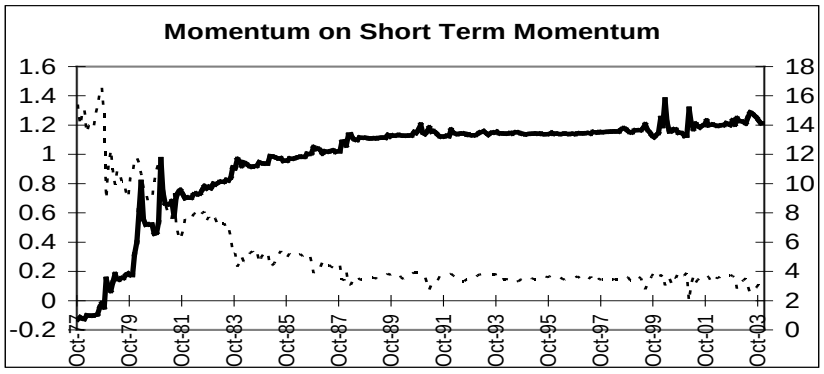
TVP Model with a Single Factor (Different Styles on Own Momentums)

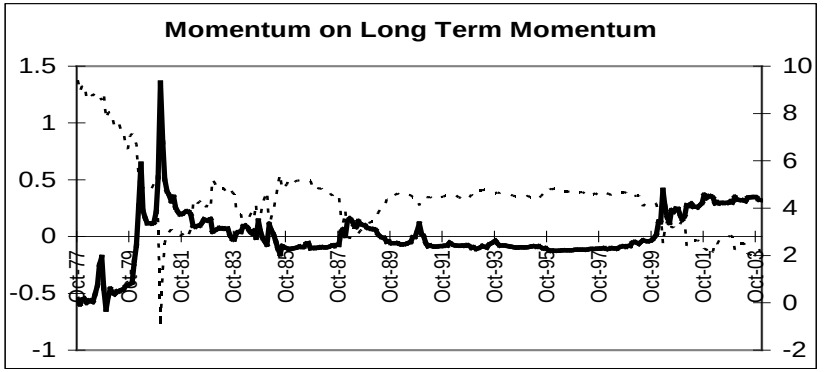




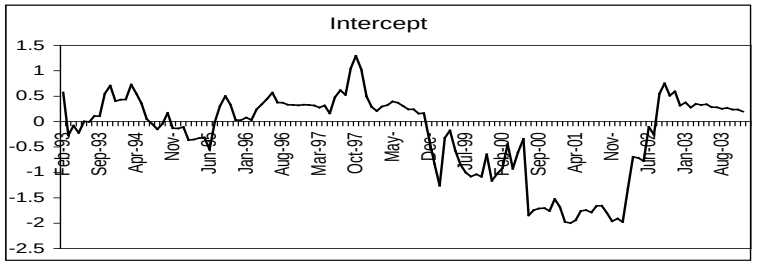


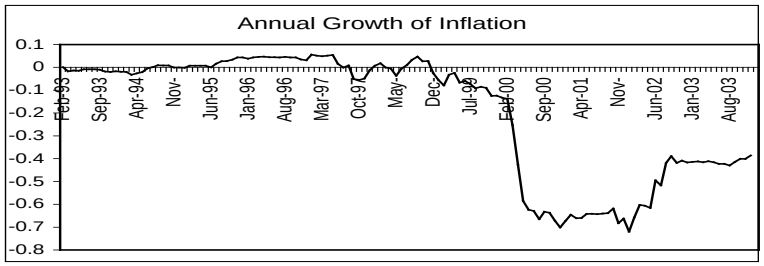


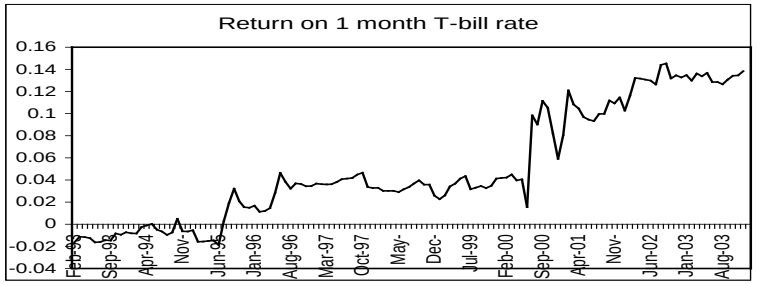


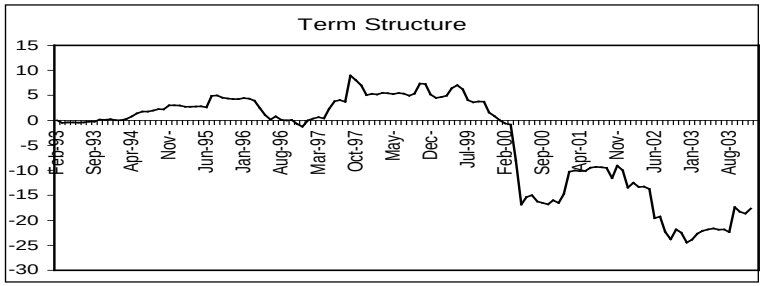


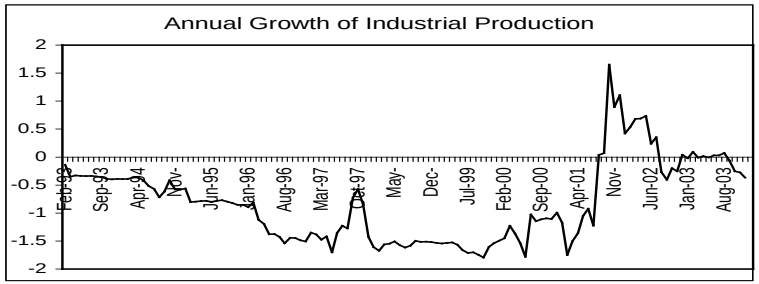
TVP Model with Multiple Factors (Size on Macro Variables)

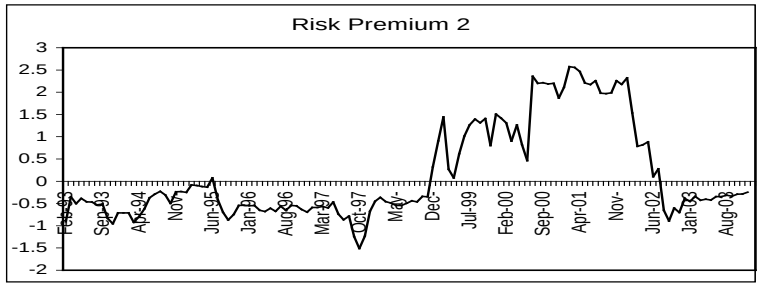


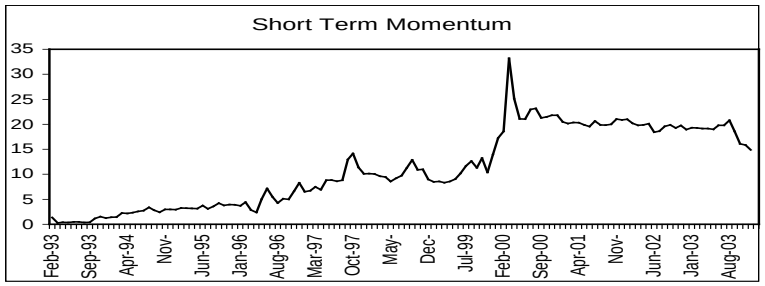


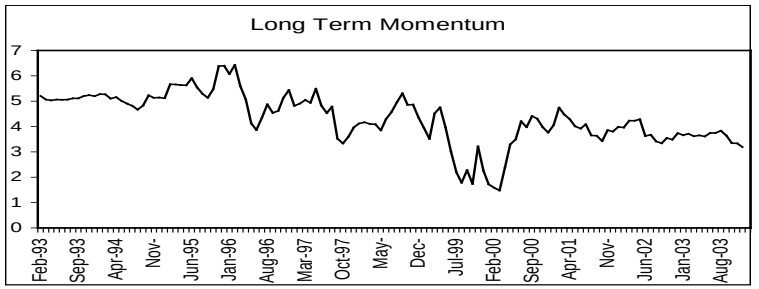












TVP Model with Multiple Factors (Size on Macro Variables)	Column1	Column2	Column3
	μ_TVP	s.e. _TVP	μ_linear
Intercept	-0.23	0.07	-0.79
Annual Growth of Inflation	-0.19	0.02	-189.01
Return on 1 month T-bill rate	0.05	0.00	784.80
Term Structure	-3.77	0.85	-15.44
Annual Growth of Industrial Production	-0.81	0.06	-4.42
Risk Premium 2	0.14	0.09	0.31
Short Term Momentum	11.21	0.67	17.77
Long Term Momentum	4.31	0.09	5.92

- A further analysis of the errors shows that on average,

  TVP model overestimates the mean, but it also overestimates the variance in in-sample fits.
- In out-of-sample fits, on average, TVP overestimates the mean, but linear model estimates are off (underestimation).
- In out-of-sample fits, on average, variance is underestimated by both models (more so for the TVP).
- In out-of-sample tests, underestimation of the returns decreases by about 40% (when we look at the sign of errors) if we use the TVP model.

  This suggests that the problem arises from not investing enough in stocks when we use the linear model.

Comparisons of the Multifactor Models (Linear vs TVP)

Model Comparisons Using In-Sample and Out-of-Sample Fits of Data:	
2004/01-2006/03	
Comparisons Using In-Sample Fits of Data:	% Change
Linear Multifactor Model Mean Squared Errors 15.636	TVP Model with Multiple Factors Mean Squared Errors 13.543 14%
Linear Multifactor Model Mean Absolute Errors 2.780	TVP Model with Multiple Factors Mean Absolute Errors 2.639 5%
Comparisons Using Out-of-Sample Fits of Data:	
Linear Multifactor Model Mean Squared Errors 9.142	TVP Model with Multiple Factors Mean Squared Errors 6.972 24%
Linear Multifactor Model Mean Absolute Errors 2.378	TVP Model with Multiple Factors Mean Absolute Errors 2.224 6%

- From a utility perspective, there is reason to believe that utilities produced by the TVP will be higher than the utilities produced by the linear models.

- West, Edison, Cho (1993) show that GARCH models produce higher utilities on average then homoskedastic, AR, non-parametric models. They claim that this is true even if MSE criterion favors GARCH only slightly.

Conclusions

- If the relationships between the macro variables and stock returns are modeled as time-varying, significant relationships can be identified.
- The changes in the relationship between macro variables and style returns correspond to important historical periods.
- Comparisons reveal that TVP models give better in-sample and out-of-sample fits compared to linear models.
- Short-term and long-term momentums of styles are also significant.
- Different macro variables affect different style portfolio returns in different ways indicating prospective gains from diversification through time.