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**Copenhagen  
Business School**  
HANDELSHØJSKOLEN

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## Executive Summary

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## Introduction

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Figure 1: The Overall Structure of This Paper

**Part I – Background and Previous Research**

- The concept of the expectations hypothesis
- The rejection of expectations hypothesis (Fama/Bliss and Campbell/Shiller)
- The concept of time varying risk premia in finance

**Part II – The Single-Factor Model of Cochrane and Piazzesi (2005)**

- Introduction of Cochrane and Piazzesi's single factor model
- Key concepts and calculations in the article, including updated analysis (including 2007)
- How to test this model on other datasets

**Part III:**

- Discussion of Dai, Singleton and Yai's tests on the single-factor model
- Analysis of the single-factor model based on other data sets to confirm or reject the model

## Method

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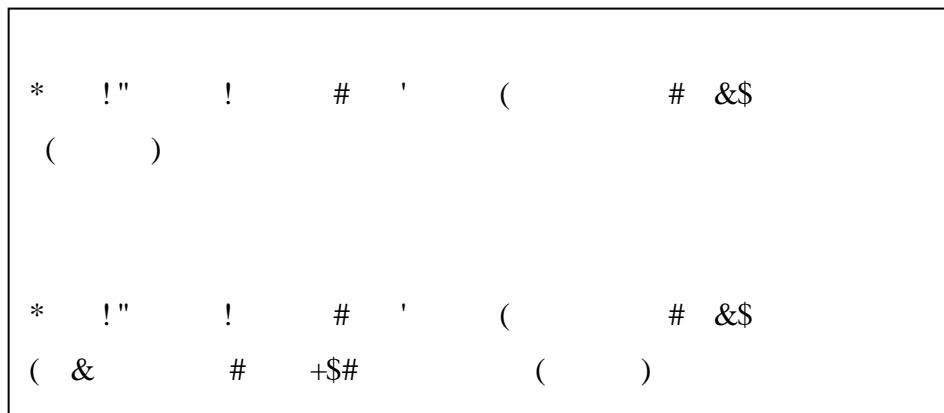
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Figure 2 – Summary of the Expectations Hypothesis



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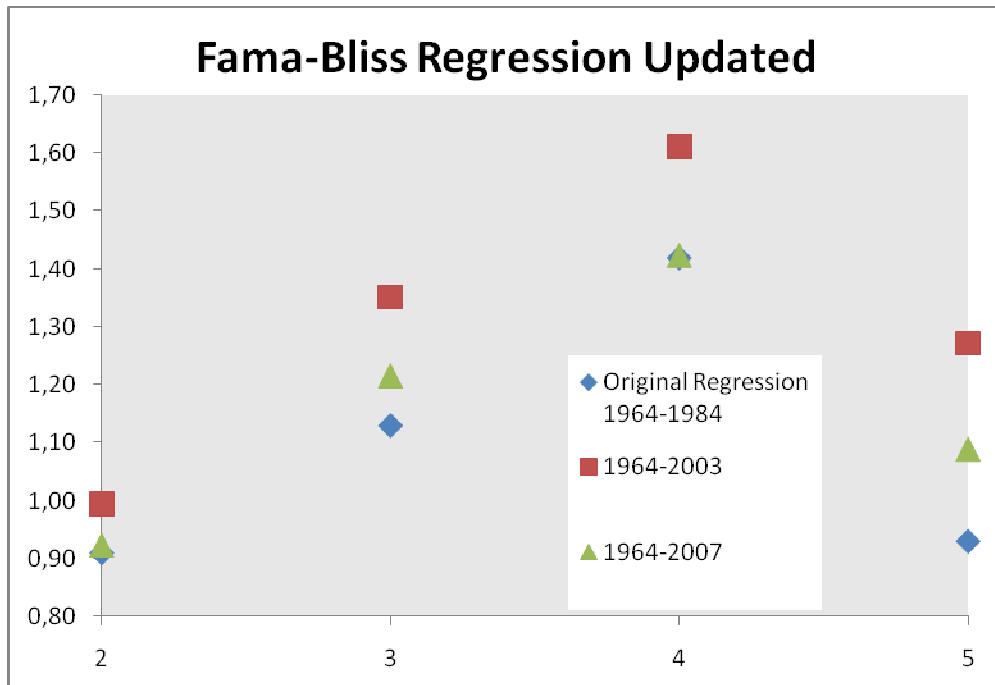


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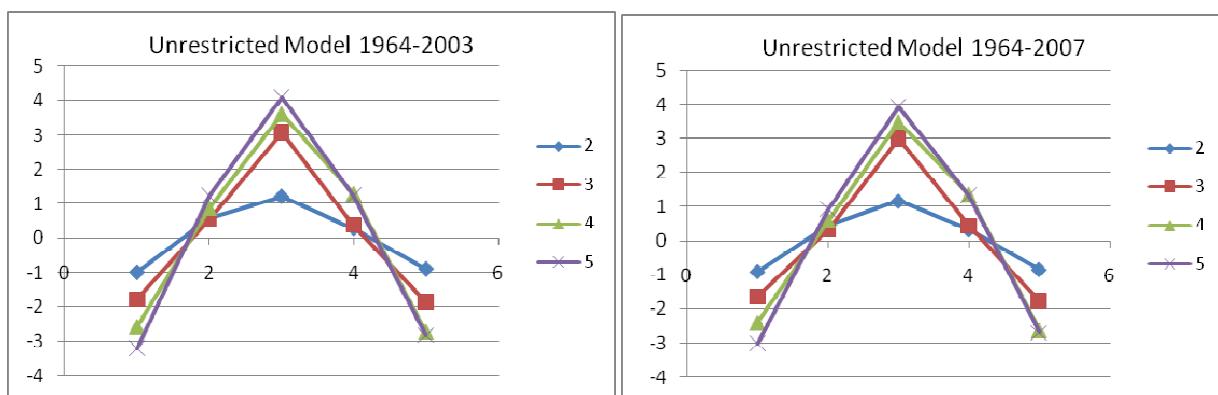
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0	1105*<	<50:	1<:5*<	<500
:	119572	<507	1<=5<7	<50=
9	**51=	<509	7)5)2	<500

### / 4 Estimation o\$ the "estricted Sin! le-' actor Model

J %+ & ), %  
 . 4450- " " ' # : ' # \$ !"  
 ! # ' # ;)

!

```

*      #   '   '   $   I   '   "   #   +   $   $&
"      (   (   #   +   #   -   "   #   )   )   %   "   )
I      $&   '   %   (   (   !   #   <

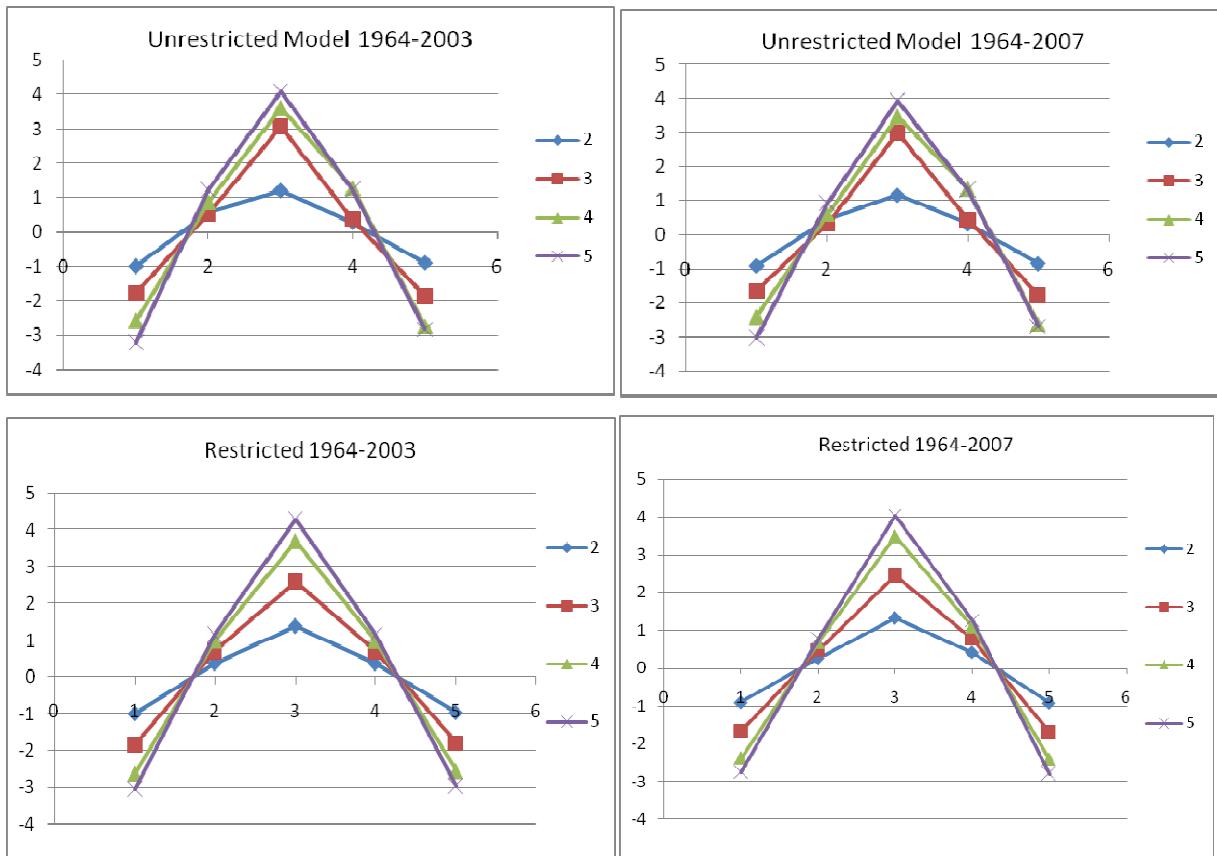
```

\* +& + ' \$ ' ' % +% ( ( \$ ' ( & !" # ' # ) + ' # ! # + <

& 0D!

\* # ' + !8 ! '\$ '' #  
# - # & \$ ' % # ) \* - # ' # +  
' #%" % )  
  
" & % # \$ ( '' ' ( %+  
" \$ % )

Figure 4 –#estricto' Oo' el vs5&nrestricto' Oo' el



\*        #        "        "        "        "        "        +#        #
   
 &        -#        + (        ( #        \$ (        MN'        "        ) \*        \$&        +
   
 "        '               #        -#        +        "        ( 8 ) ?
   
 -#        L        .L        '        (        0 "        '        %        \$ "        '
   
 " " ),        " (        \$&        . 4450        '        +        +        &
   
 #        -# ) \*        '        '        #        ( &        ( +        %
   
 &        "        '        '        ( \$ ) 9 % ( +        . 4450 "        # +
   
 , %        % #        " 8+        \$ ! "        '        +        #
   
 "        '        '        '        '        !        # )
   
 '        % ( + (        \$#
   
 %        #"
   
 ) C#
   
 #        "
   
 +        '
   
 ( &        (        +

---

<sup>8</sup> \*        "        ( #        \$ (        '        &        "

---

&+ % ( + # )\* #  
" # # & ( % & % & " ( # \$ ( )\*  
" ( !+ & ' ' +  
\$ )\* # + ' ( \$ &\$ " ' )

. 4450 ' # ( # # )\* ' # " " "  
% ( " # ' \$# ' )\* ' # " " '#  
\$ " " ! ) <

9 9  
J % &7 1  
" ' 9 9  
J ( " "

? \$ \$ % % + ' # " " " # ' G  
\$ ( " ( # ' 5 ) \* # + ' ) ? + \$ %  
" ' ( # ' # ),  
- # \$ + % & % # ! " "  
+ \$ \$ ( )

## Ta le , – Single Factor Oo' el Estimates

S189:6-F-; .<0 M<76:							
Perio2	? <sub>&lt;</sub>	? <sub>1</sub>	? <sub>2</sub>	? <sub>0</sub>	? <sub>:</sub>	? <sub>9</sub>	. <sup>2</sup>
1)=: -2<<0	-052:	-251:	<5*1	05<<	<5*<	-25<*	<509
1)=: -2<<7	-25)	-15)0	<599	25*0	<5**	-15)=	<500
	62(9+						
3orrection	1)=: -2<<0	1)=: -2<<7					
12 &ags	*1150	: *5:					
#C 1* &ags	1<959	*)50					
Simplifie2	: 25:	: <59					
#o Overlap	225=	205<					
	1)=: -2<<0				1)=: -2<<7		
n	b <sub>n</sub>	. <sup>2</sup>	1nrestrictie2 . <sup>2</sup>	b <sub>n</sub>	. <sup>2</sup>	1nrestrictie2 . <sup>2</sup>	
2	<5: 7	<501	<502	<5: 7	<501	<502	
0	<5*7	<50:	<50:	<5*7	<500	<500	
:	152:	<507	<507	152:	<50=	<50=	
9	15: 0	<50:	<509	15: 0	<500	<500	
1F: @ Sum(b <sub>n</sub> )	15<<<				15<<<		

## 6 4 5pdatin! and Comparin! the ' ama and %liss () \*+, - "esults

\* . / 120 ( ' ' ' 53 3 +
   
 % " , ' " ) \* " ' . / 120%
   
 . 4450 # + # \$ " ) \*
   
 . / 120 % \$ " , ' " ), % ( # \$ \$ %+%
   
 # + # \$ " ( # ' \$ 5 \$ ( )
   
  
 \* # ' ' ' . / 120 ' ' ' 53
   
 3 ' 23 13 +% ' \$ % ' . 4450 +%-
   
 3 23 )? % + " ' # ! " 5 & # &+%
   
 " ' " ( ' # 8-8)

Table 2 repro' uce' – Fama! "liss #egression\* #2 an' +2 ! &p' ate' 6

Maturity n	Original regressions 1)=::<1-1)*::12			3P Time Period 1)=::<1-2<<0:12			1p2ate2 To State 1)=::<1-2<<7:12		
	E	.2	62	E	.2	62	E	.2	62
2	<5)1 @@	<51:	1<5=	<5)) @@@	<51=	1:5)	<5)2 @@@	<51:	105*
S>e	(<52*+			(<52=+			(<529+		
0	1510 @@	<511	)50	1509 @@@	<517	1950	1522 @@@	<519	105)
S>e	(<507+			(<509+			(<500+		
:	15: 2 @@	<511	1<5<	15=1 @@@	<51*	125)	15: 2 @@@	<51=	115=
S>e	(<5: 9+			(<5: 9+			(<5: 2+		
9	<5)0 @	<5<9	051	1527 @@	<5<*	:5*	15<) @@	<5<7	:5=
S>e	(<591+			(<59*+			(<591+		

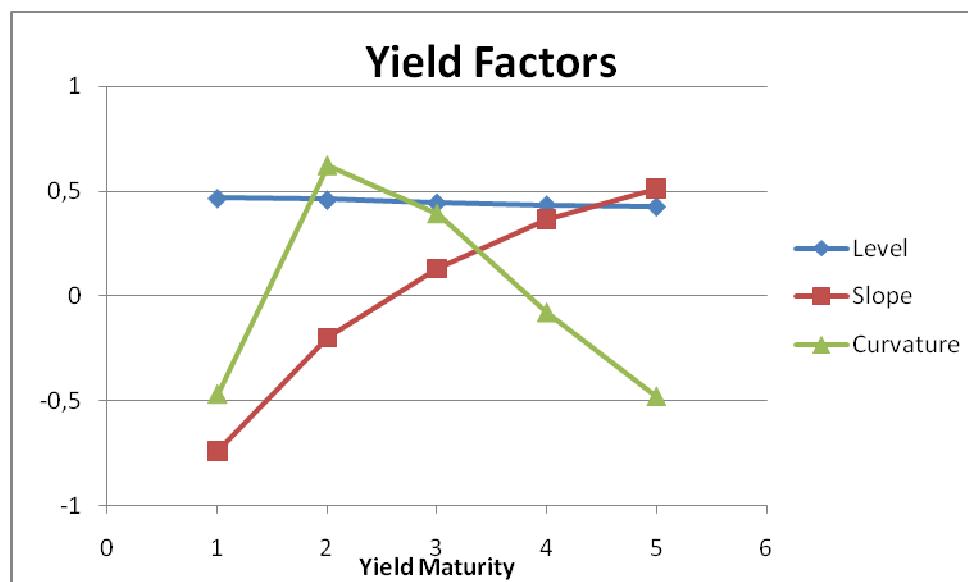
#### 7.4 Comparison 3ith Models o\$ the Yield Curve 'actors

&      # #      #      ( + "      # ( # '      %      '  
&      # ( )

#### Yield 'actors

? "      "      "      & +      ( #      "      +      "      (      '  
"      "      )7      .      0&      +      '      "      (      '  
'      & ( + "      # ( # ),      #  
'      +      %      #      <

Figure 6 – Yield Factors 2184–1299%3



2, .HHD      53      &%      "      +      3, .HHD      "      43      ( + %  
(

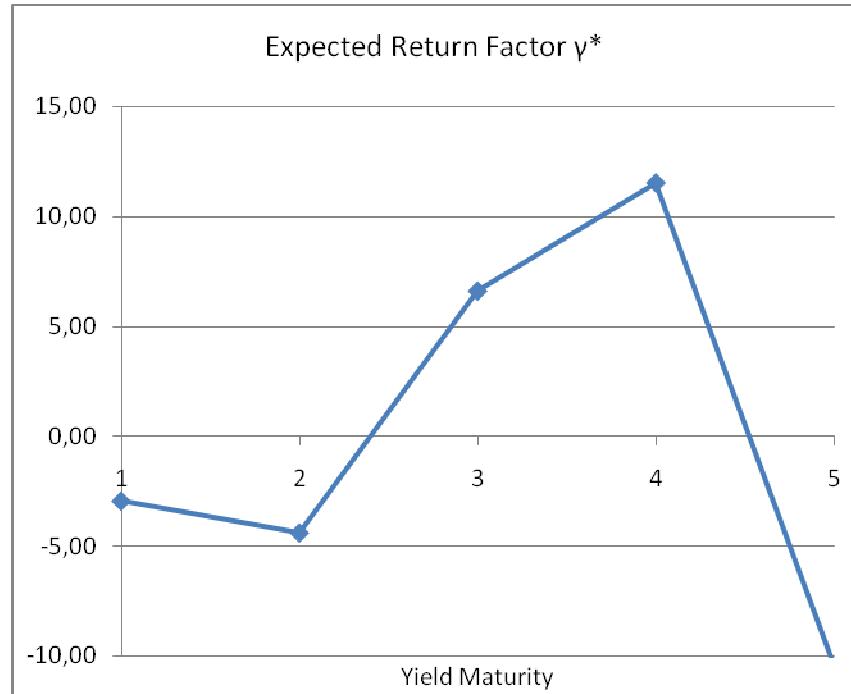
---

? + % % # ' " "#' '( )? " " "  
& ' & # ' ' + ( ' + ( "  
" " " + ( + !" / 1.543 ' ( ' & ) \* ! % ' + "  
# ( # !" + 3 4.4 3 " ( &<sup>1</sup>) \* # + " " "  
\$ // ) / 23 ' & ( )  
  
\* ( # \$ - # % ' &\$ ' '  
' % & ' ! # % + ' + ' '\$  
\$)  
  
& ' \$ !" \$&& ! # + # ( '  
' # \$ ( + # ( ' + ' ' ) \*  
" ' & % & & . ) ) ( '  
! # 0, ' & \$ - # & + ( & & '  
# \$ \$) ? ' # \$ % % + \$ ) \*  
& ' " ( # ' # &\$ ' # & + " +  
# ( :% ; ) \* ( ' # )

---

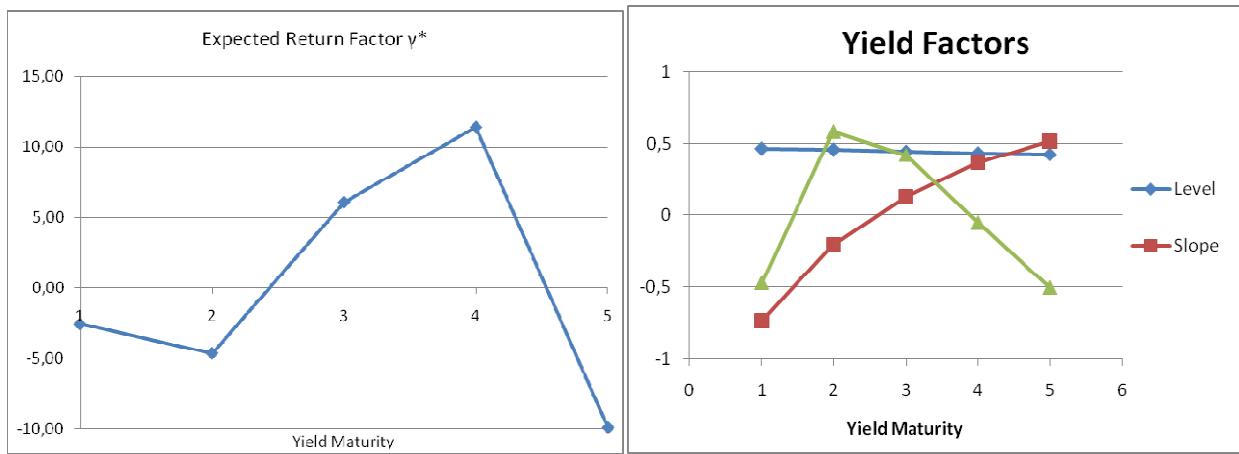
<sup>1</sup> \* . 4450+ & / 1.8+4+ 4.4 " ( & " " ! /

Figure : – Expecte' #return Factor ;< () \*97-/006-



? #"  
# &  
# %  
' !  
# \$ %)\*  
# ! 5)

Figure 8 – 7iel' Factors an' Expecte' #return Factor &p' ate' 2184-!29963



\* ! # ( & % ( +  
" ) , ' & ! ! # % ! # % #

---

+ ! ' " " "  
 & # )  
  
 \* ' % % \$ 53 / 8 44 " ) \* %  
 ' " & ' ' + #  
 \$ \$& . 4450<  
 \$\$\$ % & !'  
 9 +! & ' \$ \$ %+ & + #  
 & # ) ! " +' " + ( ' " ' # " % & ' !  
 ' # ' & # ) ? . 4450+ " % &  
 +. , ( ' \$& 0)  
  
 ? G " ' ( \$ + % & & -# ) ?  
 " ' ' ' -# + #  
 " \$ ) \* " & ' . 4450 # + " " "  
 & " ( " ( " ' % ) \* & % (   
 ( & + " \$& ( )  
  
 \* # % # # & & ( ( ( + #  
 ' 83 # " 53 ' ) \* " " "  
 " # + ( \$ ' & ' ) )

Table 4 – Forecasting with 7iel' Factors vs Single Factor Oo' el 2184-!299%3

Y16:7 F-; .<04	R-45/-06	N6=62 C 64. C31-45/-06	S1>?1@67 HH C31-45/-06	1 ?60;68. ;01.1; -: A-:/6
Slope	<522	=25*	2051	1050
&evel5 slope	<52:	075<	2<59	1150
&evel5 slope5 curve	<52=	025)	1*5<	)52

6 " & # / 8 442 " ) J % ( %  
 J % & 7 ' ( " " \$& # 43 ) K &  
 " / 8 44 ) \*

## Table 6 – Forecasting with Technical Factors vs Single Factor Model 2184-129963

R193. 3-87 A-01-B:64 R-45/-06	N6=62 ( 64. C31-45/-06	S1>?:1@67 HH C31-45/-06	1 ?60;68. ;01.1;-: A-:/6
Slope <52<	=52	215:	1050
&level slope <520	215*	1752	1150
&level slope5 curve <52=	2)51	1759	)52

## Simple Spreads

? " " ' # " & +& " ! # " " +  
 # . / 120 \$" . // 0+ \$ " , '  
 " " )? ( \$ ( -# \$ & ' "  
 "  
 7 " " " " + . 4450 ( & " \$ %  
 5 & & & )\* ( # ' . / 120  
 \$" . // 0+ ! " )J ! + &# & 5 & & " &  
 % # \$ # ' ( " +' & ' ) ' "  
 " " % ( + & +" ( & + & & +  
 & " # \$& ' )J %+\$& & + & & +  
 53 + " " \$ ' )  
 \* " ( # ' J % & 7 G 44 4/ " +%  
 " ' 9 9 & / 43 ( . " ( # O44/1 0 ) + " \$ %  
 & 5 & & + " \$ % & 5 & & "  
 ' )K \$ ' & " % . 4450

## Table 7 – Simple Spreads vs Single Factor Model 2184-1299%3

S1>?:6 S:06-74 R-45/-06	N6=62 ( 64. C31-45/-06	S1>?:1@67 HH C31-45/-06	1 ?60;68. ;01.1;-: A-:/6	5 ?60;68. ;01.1;-: A-:/6
y(9+ - y(1+ <519 *959 0<52 1050 )59				
y(1+5 y(9+ <522 :957 2:5= 1150 75*				
y(1+5 y(:+5 y(9+ <500 )51 :5= )52 =5<				

\* " # & ! &% . 4450' % " ( '  
 ' +& )7 ' # ' " " " ' & \$ 44 " +  
 ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '

---

& ' # " +% : ( & ' # ' ( & & " ;+  
 !" + " ' ' )  
  
 ? % ( + ' & & ' + ' '\$  
 ' ' . 4450 " " " -# & ! " %  
& ' + 5 & & # )? + 5 & &  
" " ' ' ! # )  
  
? #' & ' " / 8 442 ( % # +\$#  
& \$ ( % ." ( # ' 445 4+ 5/ " ( &)

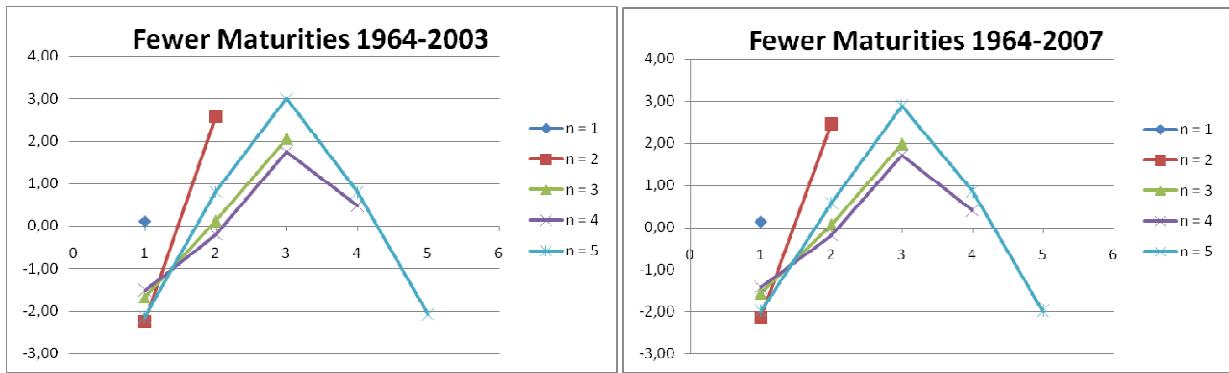
### Table 8 – Simple Spread's vs Single Factor Yield 2184–1299%

N6=62 ( 64.	S1>?:1@67 HH	1 ?60;68.	5 ?60;68.
S1>?:6 S?06-74 R-45/-06 C31-45/-06	C31-45/-06	;01.1;-:A-:/6	;01.1;-:A-:/6
y(9+ - y(1+ <519 )95:	0150	1050	)59
y(1+5y(9+ <522 :15<	2250	1150	75*
y(1+5y(:+5y(9+ <502 *50 :50 )52			=5<

### 14 "robustness Test 3ith "espect to : umber o\$ Maturities Included

? -# # # '& ( & ' # \$ ' ( \$ # +  
 % " ( & + % + ' # ( \$ # ),' "  
 ( + + # & \$ % + ( # \$ ' / 8  
 ( \$ # )9 % ( + ' # \$ % % + # " % \$ " ' / 8  
 44 / 8 442)

Figure 19 – # of Maturities with respect to Number of Maturities included

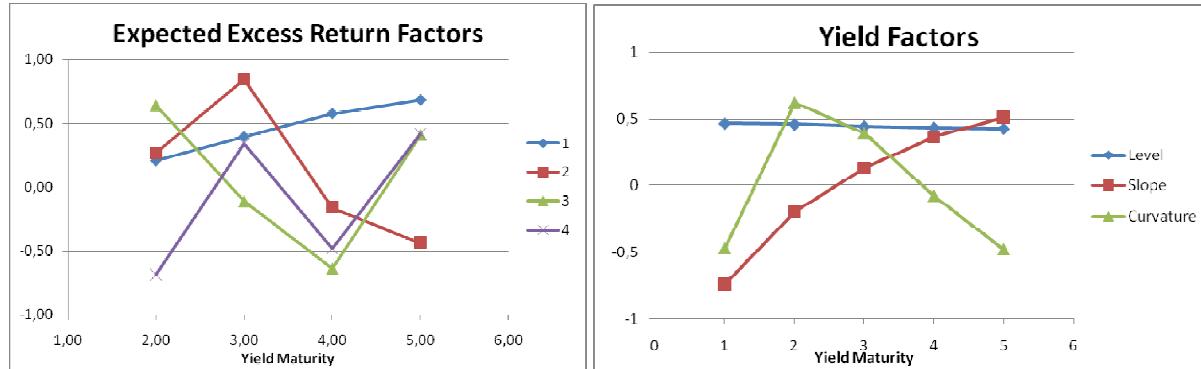


### Intermission: Model Selection and Consequences

' + ( & \$# % . 4450 ) 9 % ( + % ' ' \$ % # # \$ " + ) , ) - # & % ' + # ' ' # \$ # ' # ) \* # % # \$ \$ +\$# . 4450 # ( # \$ ' ) ) \* \$ L " ' + \$ & " ' " " ) 9 % ( + ' % " " % & ' ) + ! " + # % + ' " 9 9 J K( " + % 90 % & 7 \$ & ' ) \* % ( ( ! " + % \$ ? " " % " " " & ' ! " ! # ( ) , + % % ' " " " " ( # " ' ( ! ' ! " ! # + ' " " " " & ) \* ' " \$ ( ' ! # + % . 4450 ! & ' & ) \* ' # \$ % " " "

" ' & + % \$ ( +% ' ' # " " " ' !"  
! # ) \* & % - # " ) " " ! ) > 5)? '

Figure 11 – Principal Components of Yield's and Excess Returns (compare)



7 + " "( % % ' # ' # & " + % ) 6 & # \$ & ' # ' # & , ' \$ # % + # % ' # % ' + ( # \$ )

L ( - # ' ' + ' ' + ' ' # & ( ( + % % ' ' " # % ' ) \* ) \$ & ( ' % \$ ( " " )

#### 9.4 Estimation of the Single Factor Model with Multiple factors

' + " # \$ % + & % " % " # # & \$ ( + % # # & % " # + ' # ? ) ? + ' # " . 0 ' \$ ( & " # & , ) ) & # )

---

\*        '                          +        #                          '        # #                          %  
 # & >                          '                          "        # \$ %                          '        "                          \$#  
 - #                          '                          ) \*        %                          #                          (        "  
 % &        "                          # \$                          "                          #                          (                          ( ) K                          &  
 " \$                          )  
  
 \*        ' & E                          \$ % # \$                          ( : ( # ; + ) ) +                          & #  
 \$                          )  
  
 \$\$\$        ( ) \*<sub>+, -</sub>        ) \*<sub>+, -</sub>        ) \*<sub>+, -</sub>        !!!        )<sub>0</sub>\*<sub>+, -</sub>        !'  
  
 ? '        +        & #                          &                          E \$                          <  
  
 \$\$\$        )        (\*<sub>+, -</sub>        )        (\*<sub>+, -</sub>        )        (\*<sub>+, -</sub>        )        4        )<sub>0</sub>        (\*<sub>+, -</sub>        !'  
 \*        +        & # \$                          '                          +                          E                                  +  
 '        +#                          (        (        (        ) ? " "        ! )        #                          " "        #  
 "                          >!        +%        P ?                          )  
  
 \*        #                          #                          \$ \$ % ) ?        \$                          +                          3 '  
 ) \*        % \$                          \$ '                          +                          !        ")

Ta le 19 – Oultiple >ags #egression Estimates 2184-!299%3

&ag	?<	?1	?2	?0	?:	?9	.2
<	-052:	-251:	<5*1	05<<	<5*<	-25<*	<509
1	-0522	-25: :	15<7	05=*	151*	-0511	<5: 1
2	-051*	-259=	1500	05: 7	157=	-05=2	<5: 0
0	-052<	-25=1	15: 0	050=	2517	-05)*	<5: :
&ags	G<	G1	G2	G0			
<	1						
1	<59<	<59<					
2	<50*	<509	<52*				
0	<501	<52)	<52<	<521			

---

? #"  
% % ( )

### Table 11 – Outliple >ags #egression Estimates 2184-!29963

&ag	?<	?1	?2	?0	?:	?9	.2
<	-25))	-15)0	<599	25*0	<5**	-15)=	<500
1	-25**	-2521	<5=7	05:7	1502	-25*)	<50)
2	-25*9	-2501	<5*9	0522	15):	-050=	<5:1
0	-25*7	-2500	<5**	05<*	250*	-05=7	<5:2
&ags	G<	G1	G2	G0			
<	15<<						
1	<59<	<59<					
2	<50)	<50:	<52*				
0	<501	<52)	<52<	<52<			

### , 4 & Test o\$ the Models ' orecastin! &ility

\* ' ' ! # # ' # # % \$ ' ) \*  
# \$ ( )

\* ' ' <

$$5 \quad (6)_7^* +, \frac{8}{7#}$$

+ " ' % " % \$ '' +' ' #  
& ' )7 " # ! " # + ' ), " '  
( & ' " # " # ( % ),  
" ' % " \$ % )

Figure 12 – Forecast (omparing the T=o Time Perio' s

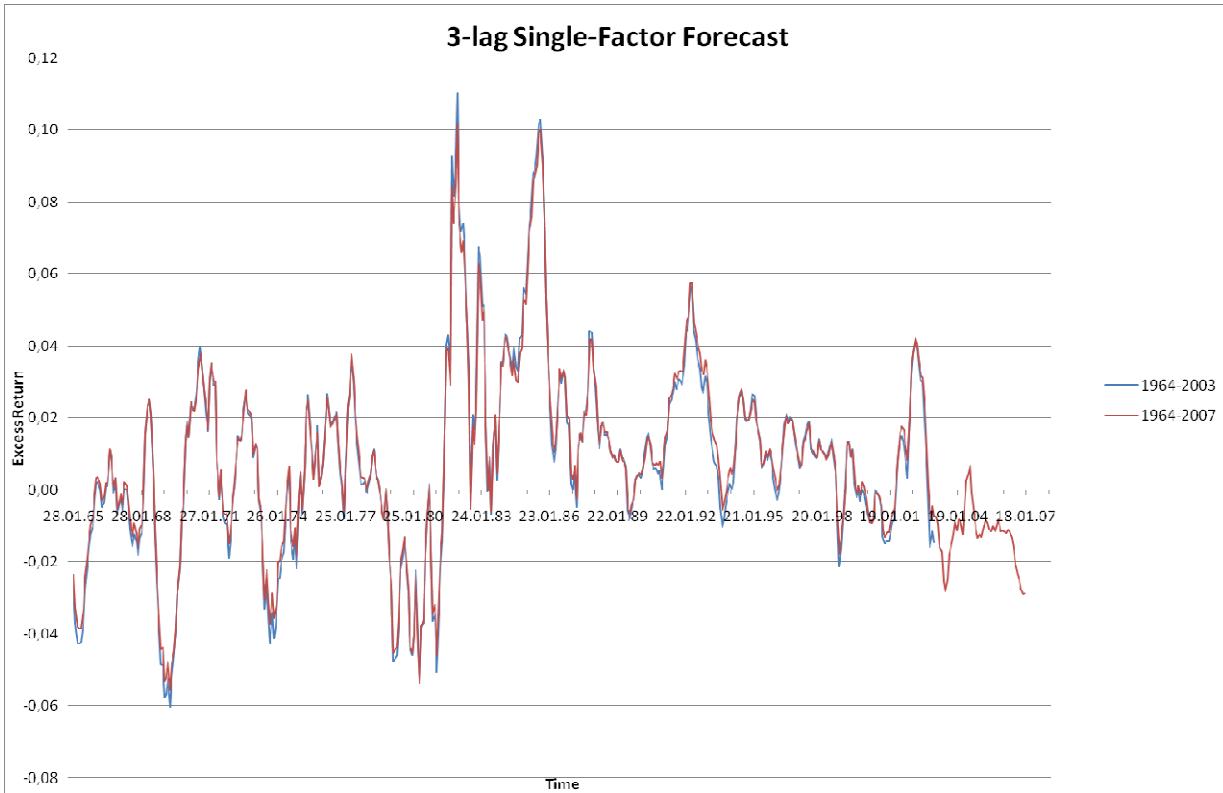


Figure 1% – Forecast (omparing Ex!post #eturns =ith the Perio' 184-!299%

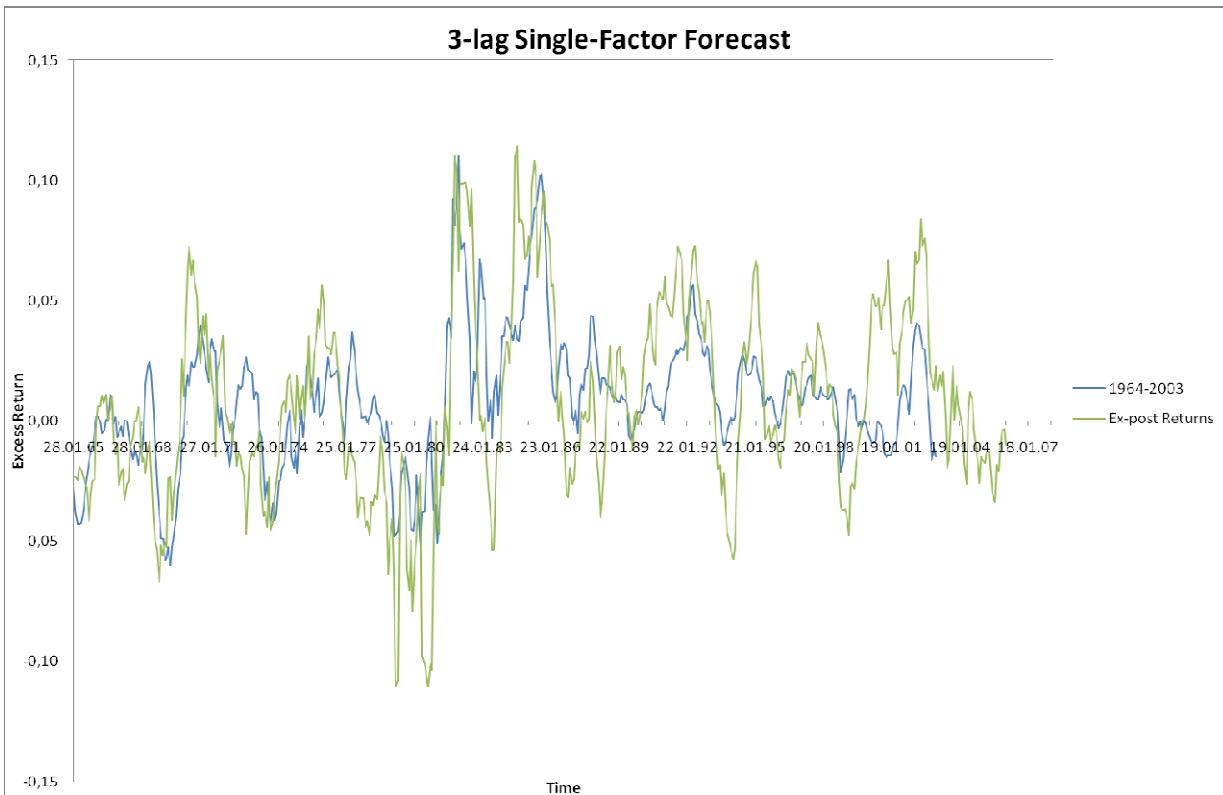


Figure 1 – Forecast (omparing Ex!post #eturns =ith the Perio' 184-!2996

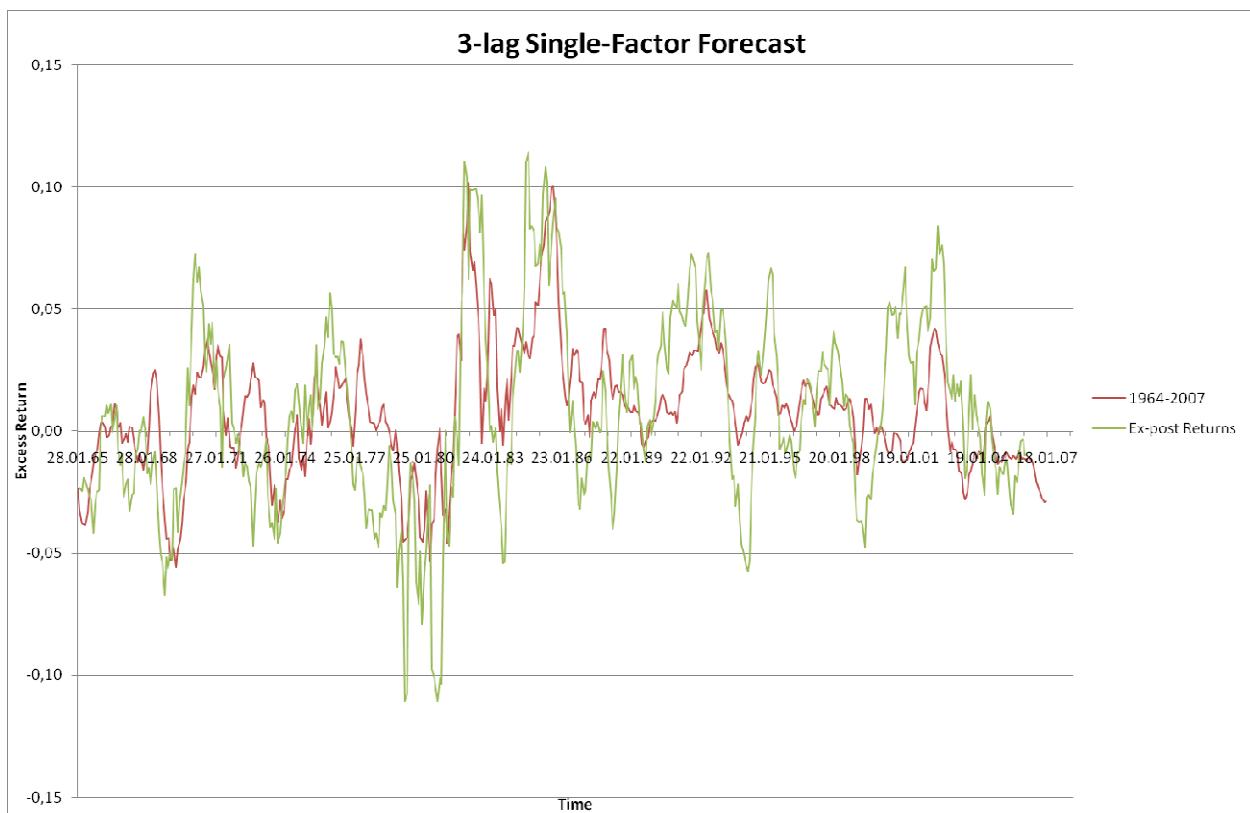


Figure 1, !Summary Part ...: The Single!Factor Oo' el of (P 2299, 3

) % )	#	#	)	\$	#		
) * #		%	+	'	%	!	#
" # )?	" "	% '#		"		+	
) * !"	&	%	)				
) ? %	+	\$		'	"	!	#
# ),	\$	#		+	( #		
" '	( (%)K			#""	( & '		)
53 )							
) *	. / 120	% #"	+	#	&	(	'
13 ) * & ' ' %					( )		
) *	& '			" "			
. / 120 '						' &	)
5) * # \$ ' ( \$ #				% #	\$&	+\$#	
" & )							
8) # " % #		& #	+				%
( ' 3 )							
2) *	'	'	'	&%	+" & "	'	( &
* + , *							
, 2 " ' % + #"				& % "	% ) ,		
& # +\$# + &' # &				'	# \$ '		
' ) *				/ 8 44 "	% ' '		
)							
	\$ #						
? \$ % #				'			
' ) *		(		% ( +			"
' % ' ! # )							

---

## Conclusion Part II

\* ' ' . 4450 "" \$ ' ! \$  
# # ) \* ( & ( ' # + # ""  
% ! \$ # ' ( # & # &

? \$# ' % ' &% \$ ( + \$  
" " # ' " " " ' & + & " +%  
' ) 9 % ( + \$ % # + # ' +  
' ' ) + ( '  
" ' ' ' ! # )

+ ' % " ' + %  
\$ #%" % + ) , ' + '  
. 4450 ' # % & # ( # \$ ' +% \$ #  
\$ ' )

\* # ' ) K  
% & " " ' . / 120 \$" . // 0  
% " + " ) , , , %  
6 ) % ' ># " +# ' % \$ \$ \$ ( ) \*  
# ' " \$ & " )

---

Part III: Testin! the Sin! le-' actor Model on >ther ?atasets

## Previous "esearch

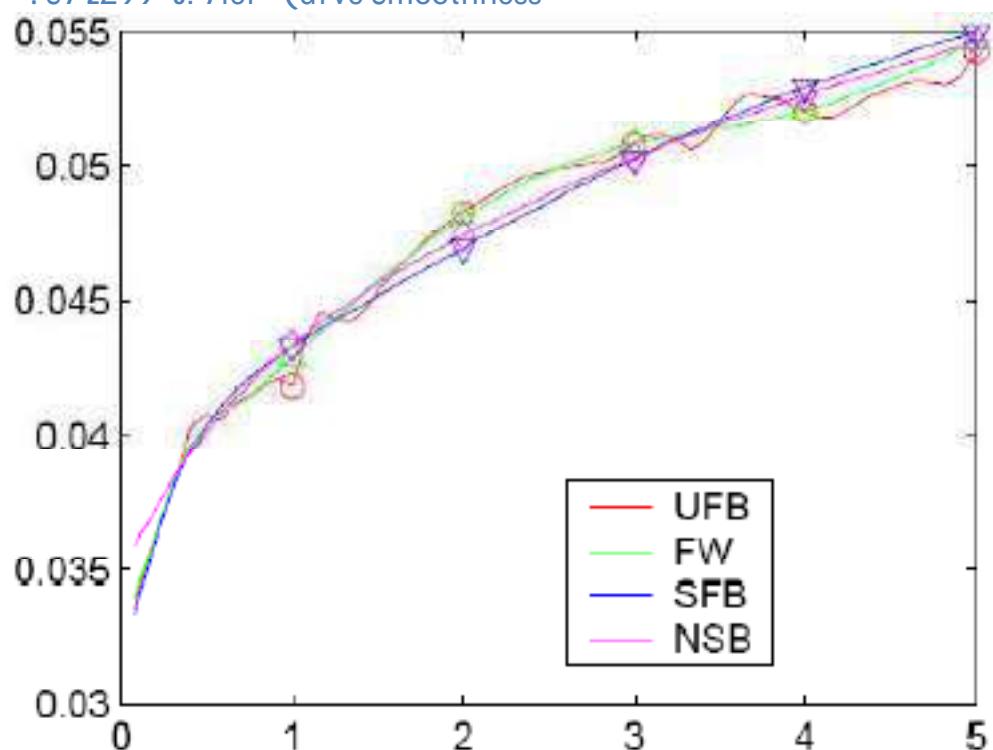
L ( " " # ' . 4450+ ' # +  
& \$ " ) ' + " # ( #  
" . 4450\* % % \$&C + Q / . 44 0  
( -# ) ( " -# "#\$  
" + . 44 0<sup>4</sup>)

( -# " #")\* ' ' # -# ' %  
+ # \$ " \$ + -# %  
% " ( ( ! \$ ( + " + # ( )\* -# ( ( " &#  
. 4450 ), : " \$ & " " " #  
' # # \$& # ; +C Q . 44 0

\* \$ # ' C Q . 44 0 % ' " +%" "  
# +) ) ' # " ' # + & # ( + %  
' " ' + " " )\* # " &  
' # " C Q . 44 0+' C \$ / 2 + " # \$ % ) 6  
.6 0 # . 4450<

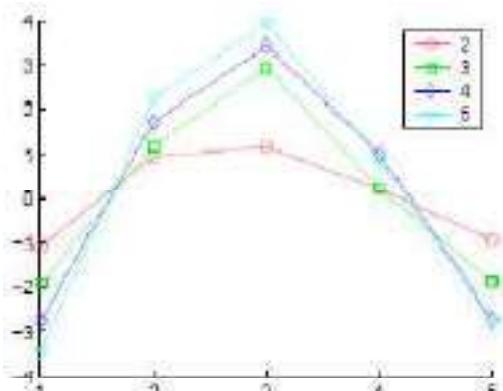
/ , C Q " " " "  
4 \* " & 44 + " " -# " &% \$ ' . 4450" " % "#\$ 445+  
# \$ % "

Figure 14 – ?S7 2299-3: 7iel' (urve Smoothness

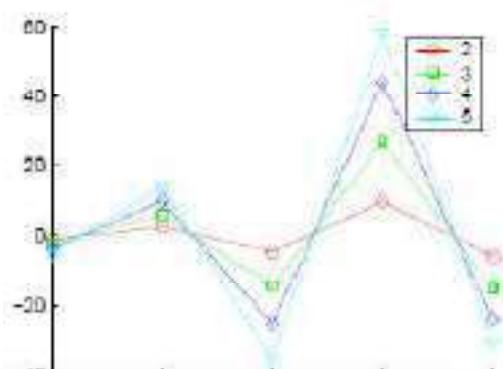


7  
( ' 6 + ) ) ( ' # . 4450+ " #  
" )

Figure 16 – S7 2299-3: Smooth vs nsmooth Data



(a) UFB Data



(c) SFB Data

```

*      . 4450 " & '      $#
(      #           " +           '           " +           " #      #
' % DR      )
"      & % ( + &      #      +      #      &
&           " "      )*      #      +      & #      ( #      '
' (      #      + #      #      $&      ( $ ) #      &      %      )
(      $      #      +      ( ( $      % &      )
*      #      "      " "      '      . 44 0      +      #
C Q. 44 0+      "      #      $      %<

```

Figure 1: – (P 2299-3: Oulticollinearity ?estroys the Tent!Shape' Pattern

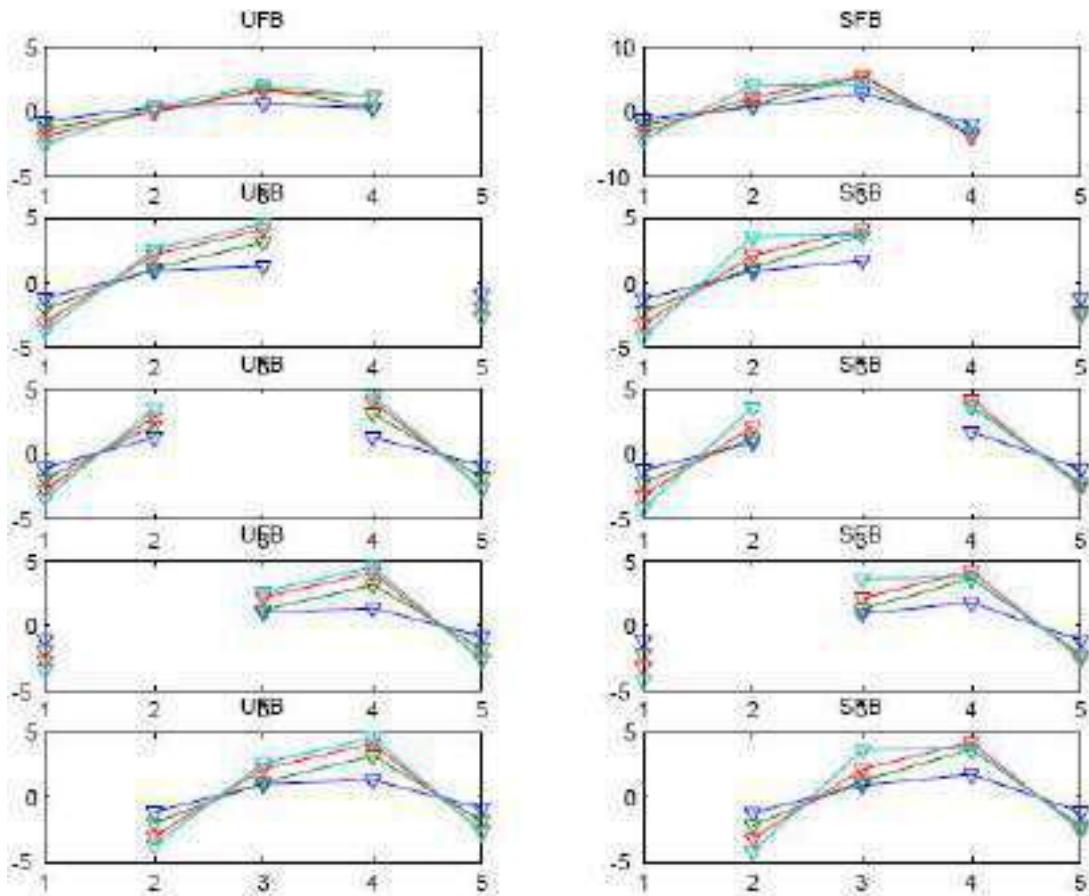


Table 11 – Previous #esearch Testing the Single!Factor Oo' el

%									
C Q . 44 0 (								) *	&"
# (					"		" "	+	#
" '			\$						"
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     # ) 9 % ( + ( # \$ # + \$ " ( \$  
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     "" ! ) ' '# " ' + " ! ) C ' "  
     # # ' " )

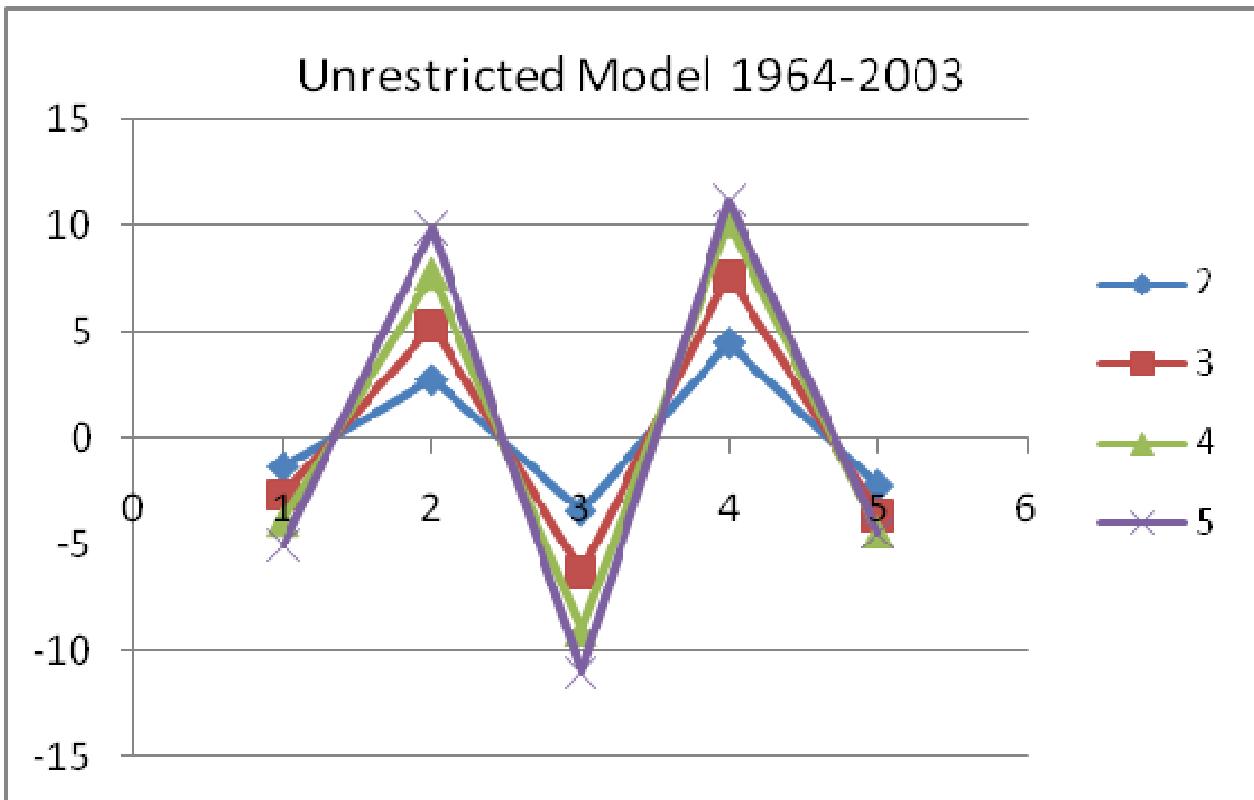
## ) 4 Estimation o\$ the 5nrestricted Model

\* ' ' ' % " # # + ' + '  
  ' ) \* " ) 9 % ( + \$ ' + " )

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"# # " \$ " 8 # " ,,

Figure 18 – The &nrestrictive' Oo' el



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Table 12! +^2an' #^2 for the &nrestrictive' Oo' el

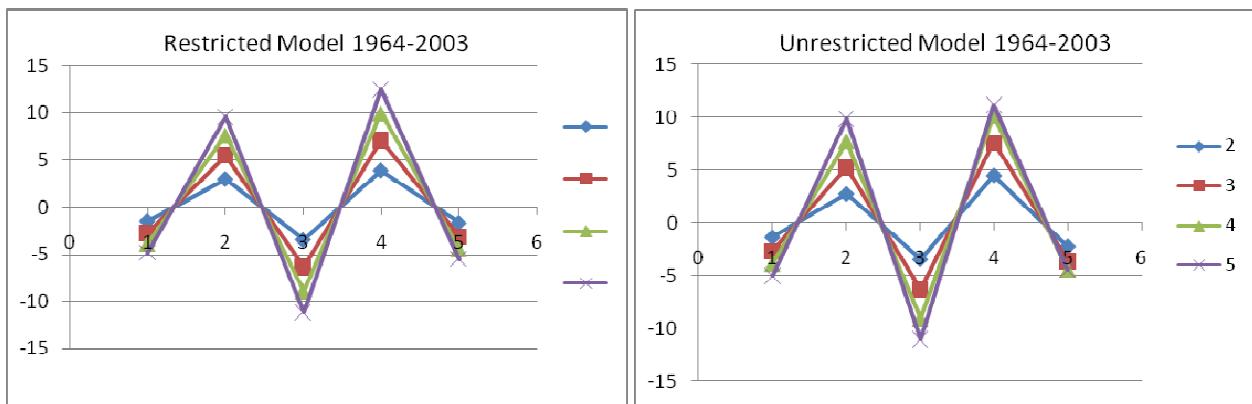
Maturity	F6760-: R6460A6		CRSP	
	3hi-sHuare (9+)	.2	3hi-sHuare (9+)	.2
2	2=5*:	<521	1215*2	<502
0	005*<	<520	1105*<	<500
:	0)57<	<529	119572	<50=
9	:05*=	<52=	**51=	<500

#### / 4 Estimation o\$ the "estricted Sin! le-' actor Model

? % # + " ) \* " ' # ' # % \$ %)

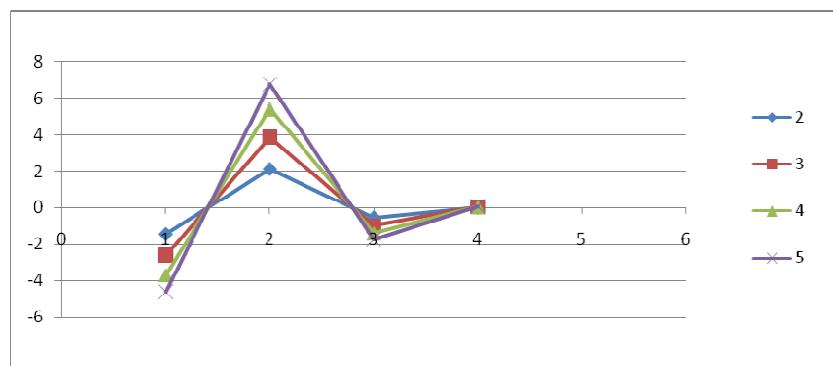
# % ( " ( + % ' # \$ %)

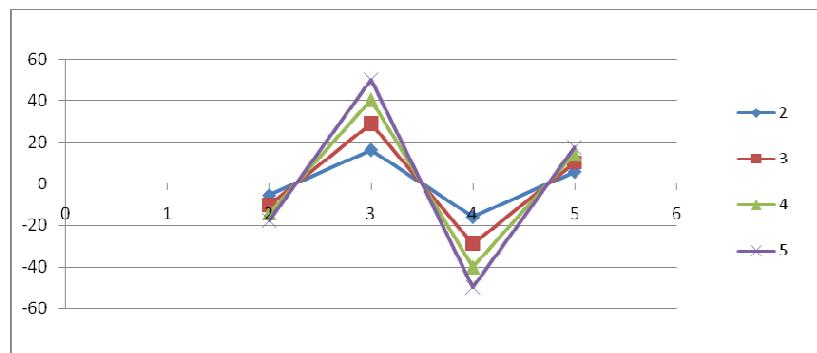
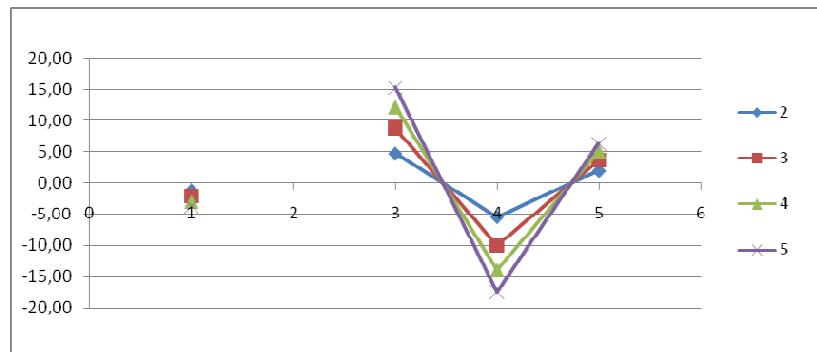
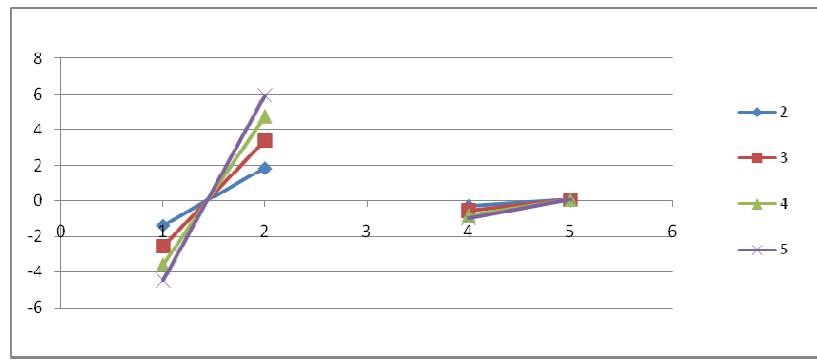
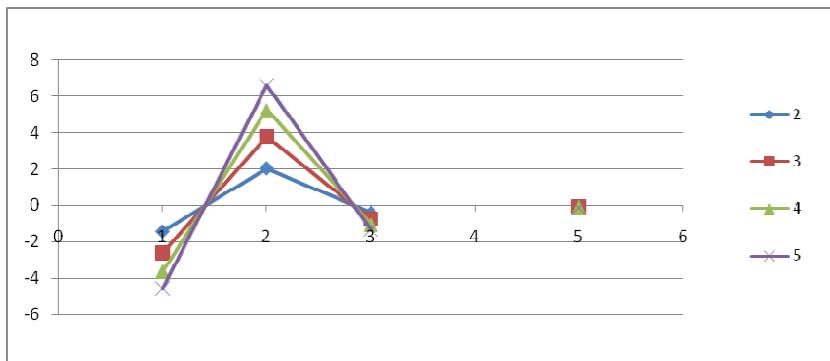
Figure 29 – #estricte' vs5&nrestrictie' Oo' el



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 # & \$ " + ) ? ' # \$ %  
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Figure 21 – .s Oulticollinearity the #eason for the Oissing Tent!Shape@





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 . 4450+ % # & \$ # 5 &  
 # &

+ " + G ( # % ' " ( &1 + 8++  
 ' 45.5 1++' + 1+ ' &' ( " +' -8 -2)  
 \* ' ( "" & \$# & '  
 ( ! " ' ( " +% " ( # ' -83 )

! " &  
 " " ' 53 53 + % \$ %)\*  
 ( ' " ' ! # +% )

Table 1% – Single Factor Oo' el Estimates .

		Stan2ar2 Errors				
	Estimates	12&ags	#eAey-Cest 1*&ags	Simplifie2 12&ags	#o Overlap	
?<	-25*9	15*<	159)	15):	25<2	
?1	-052:	<5)*	<5)<	152<	15*7	
?2	=5: <	1<5<<	*5)=	*5:<	19517	
?0	-75: 7	00511	2)571	2:5)2	:=59)	
?:	*507	: 05: *	0)5:<	025<)	9*5:<	
?9	-05=*	1)5=<	1759)	1:5:<	295: *	
6^2(9+		0=5:	0*50	1*52	1257	
.^2	<529					

@ " ' # . \$ \$ %0+ \$  
 " " % % ) \* #  
 & -# # % # ! " + %  
 \$ \$ ( + % ) "

? . 4450 % % + \$ % " ' + % ( ) +  
 ( # % " \$ % " ' M2N " ! 5 ) )

Table 1 -- Single Factor Oo' el Estimates ..

n	b <sub>n</sub>	. <sup>2</sup>	1nrestrictie2 . <sup>2</sup>
2	<5: =	<52<	<521
0	<5*9	<520	<520
:	151)	<529	<529
9	15: )	<52=	<52=

## 6.4 Updatin! and Comparin! the 'ama and %liss () \*+, - "esults

J %+ # . / 120 % "

# 3 + # ) \* ' " ' # ! " '

5 & # & % ' " ( ' # ) \* G "

( # % ' ' 8-8)

Table 1, – Fama an' "liss 218: 63 #egressions

" aturity n	3. SP \$ataset						Fe2-\$ataset					
	Original . egressions 1)=::<1-1)*::12			3P Time Perio2 1)=::<1-2<<0:12			3P Time Perio2 1)=::<1-2<<0:12					
	E	. <sup>2</sup>	62	E	.2	62	E	. <sup>2</sup>	62			
2	<5)1	<51:	1<5=	<5))	<51=	1:5)	<5)=	<512=	)5:			
S>e	(<52*+			(<52=+			(<501+					
0	1510	<511	)50	1509	<517	1950	152<	<512)	*5<			
S>e	(<507+			(<509+			(<5: 2+					
:	15: 2	<511	1<5<	15=1	<51*	125)	15: <	<512)	752			
S>e	(<5: 9+			(<5: 9+			(<592+					
9	<5)0	<5<9	051	1527	<5<*	:5*	1597	<512*	=5)			
S>e	(<590+			(<59*+			(<5=+					

? " "

5 &

# & " " & # & \* " "

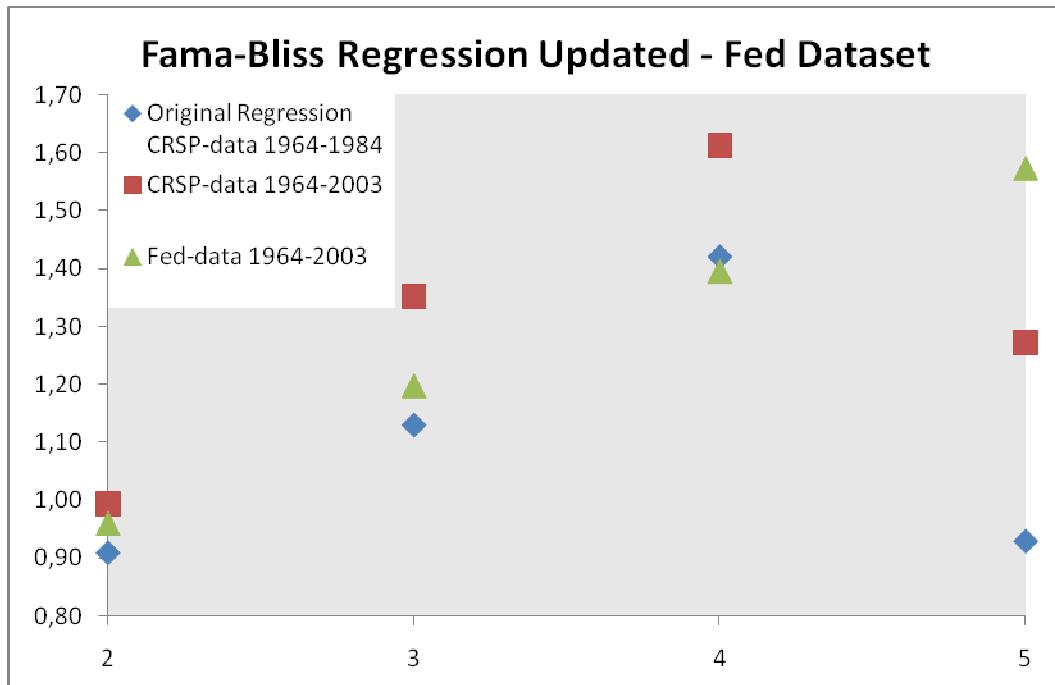
+ % " \$ %) K + & ( &

" / 8 / 1 # ' ) ) " ) "

% ( / 8 44 " % & + %

" ) # . / 120 #%" % + )

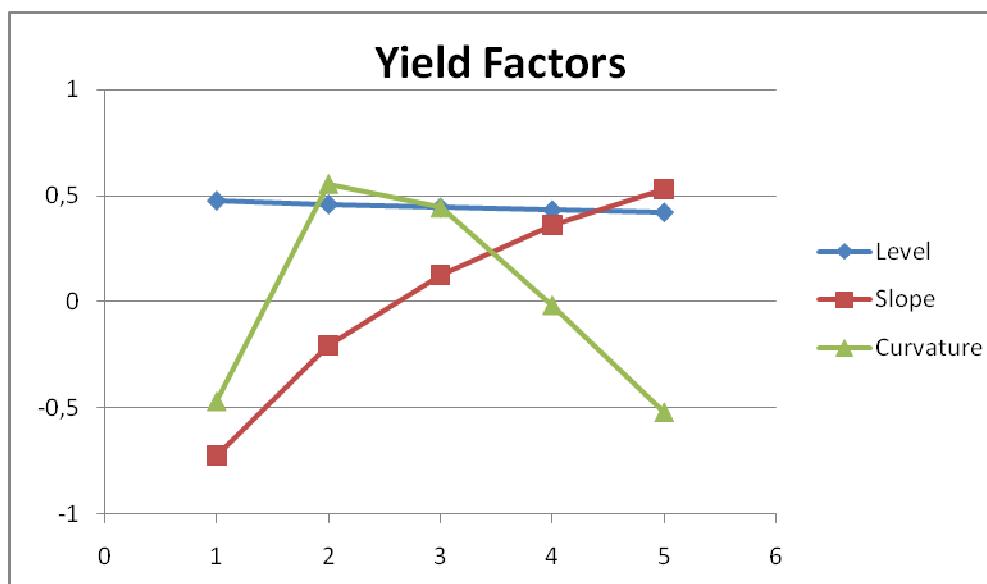
Figure 22 – Fama-Bliss Regression & Comparison



7.4 Comparison of Models of the Yield Curve Factors

\* & ' ' ) \* ! " +  
 ' " " % \$ )

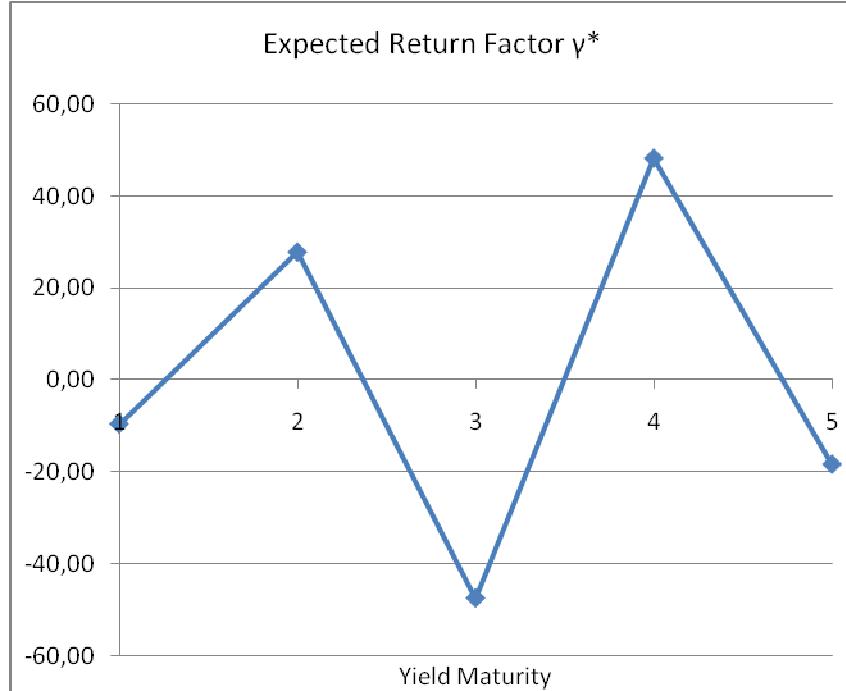
Figure 23 – Yield Factors in the Federal Reserve Dataset



---

K + !" # ' ( & ' )\*  
 " + : ; #( & & # &

Figure 2 – Expected Return Factor ;<



7 + ' % \$ " &  
 " )? \$ \$ % % + &  
 ' & " ' )\* # ' ' '\$  
 ' ! # + ' & ' )\* # \$  
 ' + ! ' \$ # ! #  
 + " )

Table 14 – Forecasting with Yield Factors vs Single Factor Oo' el in the Fe' !?dataset

Y16:7 F-;. <04	R-45/-06	C31-45/-06	N=62 ( 64. S1>?1@67 HH C31-45/-06 ;01.1;-:A-:/6	1 ?60;68.
Slope	<52<	=5*	:5)	1050
&level5 slope	<521	=5=	059	1150
&level5 slope5 curve	<529	<52	<52	)52

\* '# # " " " " " " "  
 -# &% + \$ ' )7 ( # ' 4+ 4+ +

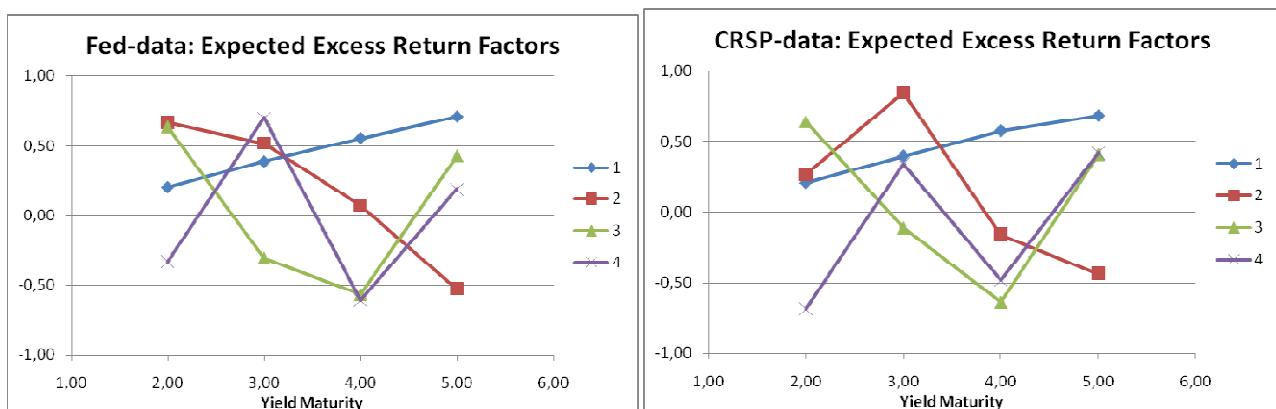
& \$ ' ' ' ( +% " ( # '  
 \$ ( ( 4 " ( +% ! " ' J % & 7 ' % & ) K & "  
 " \$ % & 5 & & +\$# % " ( # ' " ( & -53  
 8+3 ) \$ )

Table 16 – Simple Spreads vs Single Factor OOF

S1>?:6 S?06-74	R-45/-06	C31-45/-06	N6=62 C 64. ?A-:/6	S1>?:1@67 HH C31-45/-06	?A-:/6
y(9+ - y(1+ y(1+y(9+ y(1+y(:+5y(9+	<51: <521 <52:	1<5: =5) <5)	<5<09 <5<79 <5=0<	*5) 057 <57	<5<=: <52): <57<2

? ' #\\$ ! " +  
 " " " ! " ! # " " "  
 " ' \$ %) ? \$ + # \$ \$ %  
 % +\$# " " & " \$ % \$  
 # & ' % ' # \$ ( T " ' ! # " ' %  
 ( & " ' % ' # )

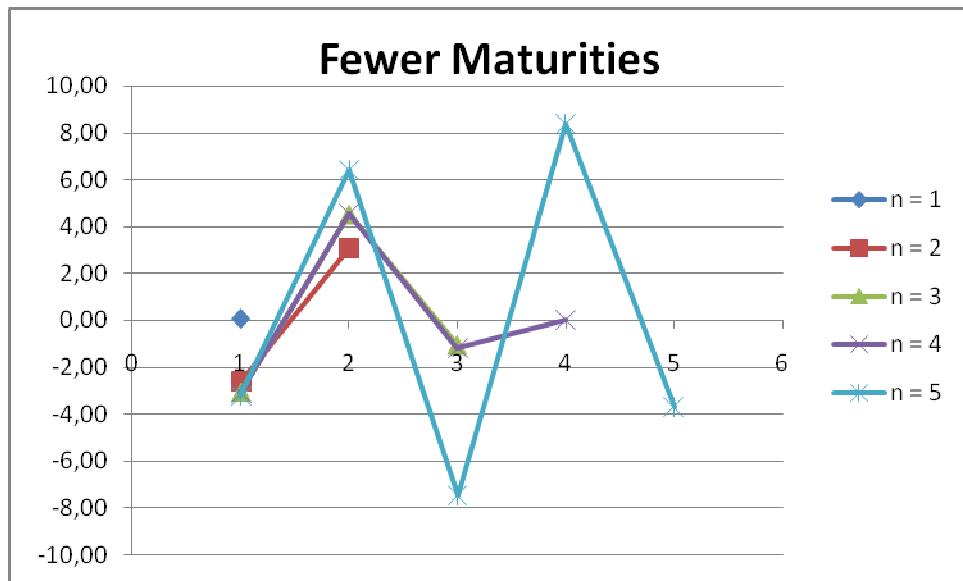
Figure 2, – Expected Excess Return Factors



14 "robustness Test 3ith "espect to : umber o\$ Maturities Included

' # # \$ ' ( \$ + \$ ' +
 " + ' & )

Figure 24 – #e' ucing 1um er of \$aria les in OOF



#### 9.4 Estimation of the Single-factor Model with Multiple factors

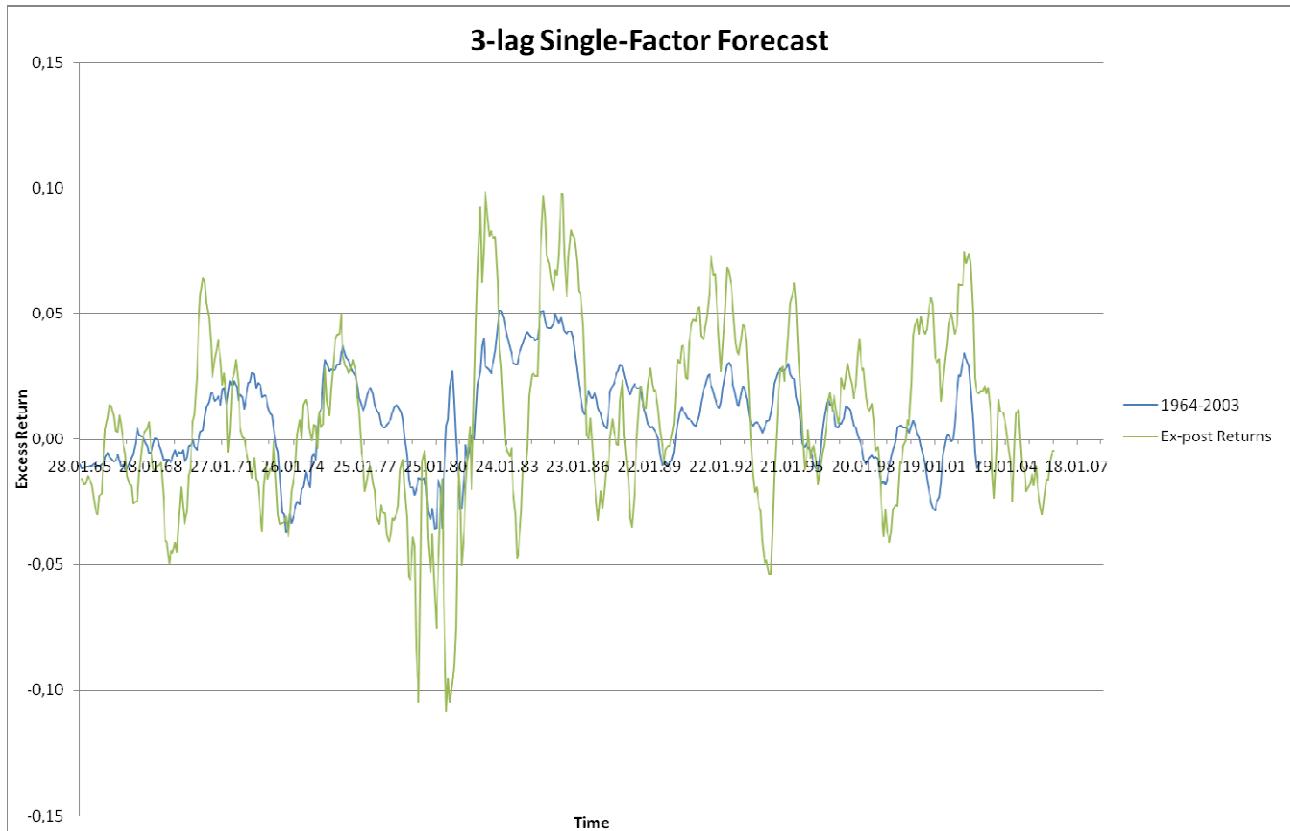
7                          + " #                  "" )?                  + I            I<sub>5</sub>  
+    #    "    (        (        (    "    ( ( # ) K                  +    "  
                            #    )?    '              '    #    % \$    %+    " 2+  
( &    '              +%    '    & 83    "              3                  )  
?    +    &              &%              +    ""              %  
) \* # +&    '    #    '              '  
                            )

Table 1: - Outpute >ags #egression Estimates

&ag	?<	?1	?2	?0	?:	?9	.2
<	-25*9	-052:	=5:<	-75:7	*507	-05=*	<529
1	-257	-050<	95-*	-:50*	:572	-250:	<52=
2	-05<2	-052*	:5-9	-<571	<507	-<5=:	<52=
0	-05<*	-0527	05)<	2511	-05<*	-57:	<52=
&ags	G<	G1	G2	G0			
<	1						
1	<5:)	<591					
2	<591	<52=	<52:				
0	<5:7	<50<	<5<:	<51)			

## 4 & Test of the Models' Forecasting Ability

Figure 26 – Forecast (Compare) to Ex-Post Returns – February 2007



## Conclusion on the Federal Reserve Dataset Tests

, ( ' ) + \$  
 ' \$ # + & ! ) \* " " +  
 " " " ' ' ' &\$ ' '\$  
 # )  
  
 ( ( \$ " ' +\$ " " \$& . 4450 "#\$  
 " " + # . 44 0 " C Q . 44 0  
  
 , + ( ' # % % % '\$ "  
 + % \$ ! +, + &  
 " ( + & # " ' . 4450 )

## The ?atastream ?atasets

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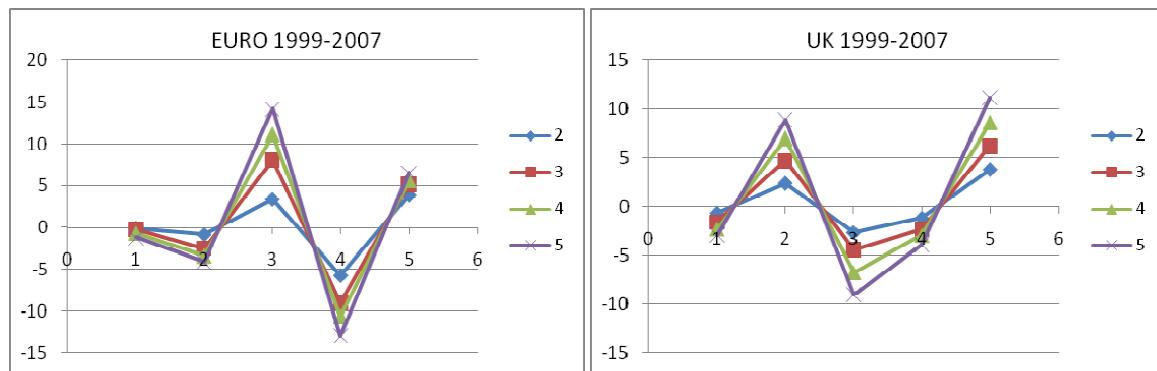
## ) 4 Estimation o\$ the 5nrestricted Model

\*      '  
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 &J    %    &7  
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 (    &    ) ?    \$    '  
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\$ ? " " ! ) C # 44 544 ' ' # " ) ? ( # \$ # )  
 ) ? 43 5 3 ' ' # ) ? ( # \$ ) \*  
 ( # ' # ' & \$ \$ # )  
  
 K # % % ( ' " +\$# ! \$ & " " ), #  
 ( ( # \$ ' # # \$ ' ( # \$ ' + ' % \$ "  
 " ,,) , % ' " ( ' " + # " &># "  
 )

Figure 2: – The &restrictive' Oo' ellipsis Patterns of the ?atastream ?ata: Euro\* &B\* Germany an' ?enmark/



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## Conclusion on ?atastream ?atasets

```
*          &># "      #"
      ( &          #      #
      (           $      %      #
      . 4450     )*      #
      ?      $      #      +      '
      '      "      +      "      &      ># "      )
      +      %      $      #
      '      '      '      '      )
```

## Conclusion Part III

Figure 28 ! Summary Part ...

) - \$ # , % C Q . 44 0 \$ ( % ' ) & & # " \$ + ' &% % % ), " & + . 44 0 ! # \$ ' # \$ ( ' & ' + C Q . 44 0 )  # % , 7 ' % % " ! + ( # \$ \$ ' # \$ " ) % ' % " " , , \$ . 4450+ % ! % # . 44 0 " & C Q . 44 0+ ' ' . 4450 ) * " + ' " . " 0+ ' \$ # \$ & & ! )  , , , * &># " ( \$ + ' & ' ) * ( \$ ' ># + ' L & 6 A C ) , + ' # # \$ % ( +" \$ & # ) * # ' \$ % % + ' #" " &># "
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## Conclusion

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# ) \* + " ( & -# & " ' "  
\$ + % ' ! " ' + # % ! # + % ( )  
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\* ( & % ( +% " \$& ! " & + "  
& ( " % ' ( & " ' )

9 % ( + ! " & % # ' . / 120  
" \$ . // 0 \* # # # " # "#  
13 ' ( & ! " ! # \$ % # & ( \$ %  
# &

\* ( & \$ " \$ ' ( + # " ' "  
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# & ) \* # ( + " ' %  
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+V 9 ) + 445)  
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+V 9 ) + 44 )  
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+>) + + ) + / 12)  
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P +K ? ) + / 22)  
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7 +9 ) + / 14)

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```
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9          &*#      :+1 2 1 1)
```

## Data Sources

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C  " ( $& # ( S  # " # )*
: * C  # ;)

, / 
#$  " $ ( %%%" ) )

? # " # ) U  & ' # #
#" ) * C M # & ND: U> K 6 P>; DM # & ND:
U> K Q,>@C; +' ! " 6 A U> K 6 P> Q U> K Q,>@C)

# % /
?( $ ' % " R%%%" ) ( ) (R R 448 1!
```

---

## APPENDIX

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OA. S1. #O2DR3C4 1" 5A6	/1
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S3MP53F31D OA. S1. #O2DR3C4 1" 5A6	/(
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U. R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	/9
*#. A5U1S F2R *O1 O&P2*O1SS *OA* 1AC0 U. R1S*R3C*1D C21FF3C31. * 1?UA5S *O1 R1S*R3C*1D C2U. *1RPAR*	/9
R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	9!
1@P1C*1D R1*UR. FAC*2R AB	9!
PR3. C3PA5 C2MP2. 1. * A. A5&S3SC &315D FAC*2RS	9!
S52P1=51: 15 A. D CUR: A*UR1 R16R1SS32. S	9!
S3MP51 SPR1AD R16R1SS32. S	91

. UM<1R 2F MA*UR3*31S	9"
PR3. C3PA5 C2MP2. 1. * A. A5&S3S 2F 1@P1C*1D R1*UR.	9"
B. CRSP) 1(6' 2007	(#
U. R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	9(
*#: A5U1S F2R *O1 O&P2*01S3S *OA* 1ACO U. R1S*R3C*1D C21FF3C31. * 1?UA5S *O1 R1S*R3C*1D C2U. *1RPAR*	9(
R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	9(
1@P1C*1D R1*UR. FAC*2R AB	94
PR3. C3PA5 C2MP2. 1. * A. A5&S3S &315D FAC*2RS	94
S52P1=51: 15 A. D CUR: A*UR1 R16R1SS32. S	94
S3MP51 SPR1AD R16R1SS32. S	9-
. UM<1R 2F MA*UR3*31S	96
C. FEDERAL RESERVE) 1(6' 200# %MONTHL* AVERAGE&	(7
U. R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	9
*#: A5U1S F2R *O1 O&P2*01S3S *OA* 1ACO U. R1S*R3C*1D C21FF3C31. * 1?UA5S *O1 R1S*R3C*1D C2U. *1RPAR*	9
R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	9
1@P1C*1D R1*UR. FAC*2R AB	9/
PR3. C3PA5 C2MP2. 1. * A. A5&S3S &315D FAC*2RS	9/
S52P1=51: 15 A. D CUR: A*UR1 R16R1SS32. S	9/
S3MP51 SPR1AD R16R1SS32. S	99
. UM<1R 2F MA*UR3*31S	1!!
PR3. C3PA5 C2MP2. 1. *S A. A5&S3S 2F 1@P1C*1D R1*UR.	1!!
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U. R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	1!!
*#: A5U1S F2R *O1 O&P2*01S3S *OA* 1ACO U. R1S*R3C*1D C21FF3C31. * 1?UA5S *O1 R1S*R3C*1D C2U. *1RPAR*	1!!
R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	1!!
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S3MP51 SPR1AD R16R1SS32. S	1!4
. UM<1R 2F MA*UR3*31S	1!4
PR3. C3PA5 C2MP2. 1. *S A. A5&S3S 2F 1@P1C*1D R1*UR.	1!-
E. DATASTREAM) 1((8 2007	106
U. R1S*R3C*1D C21FF3C31. *S=R => " A. D S*A. DARD 1RR2RS	1!6

## Appendix 1 – Data

### A. CRSP

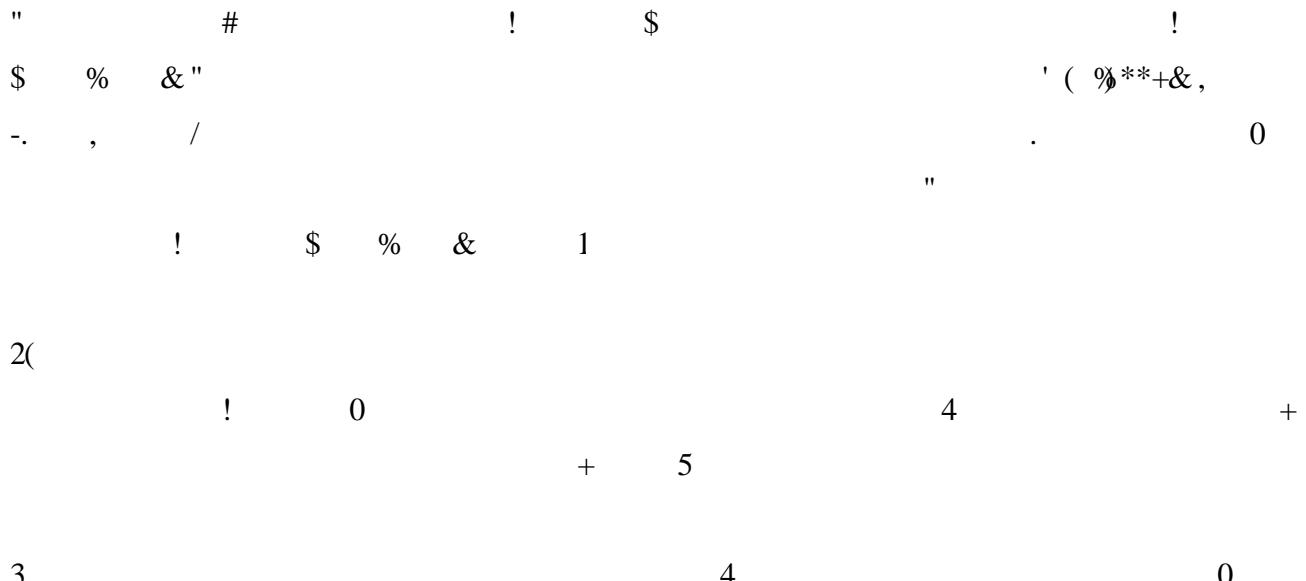
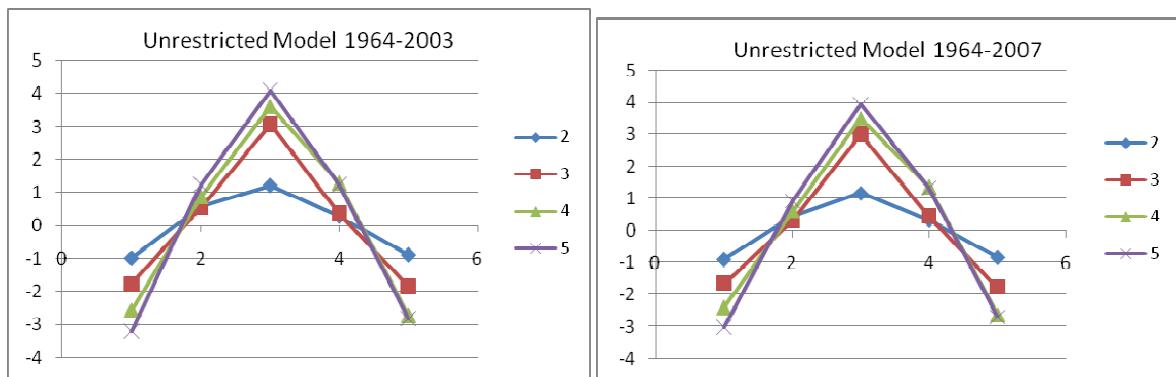
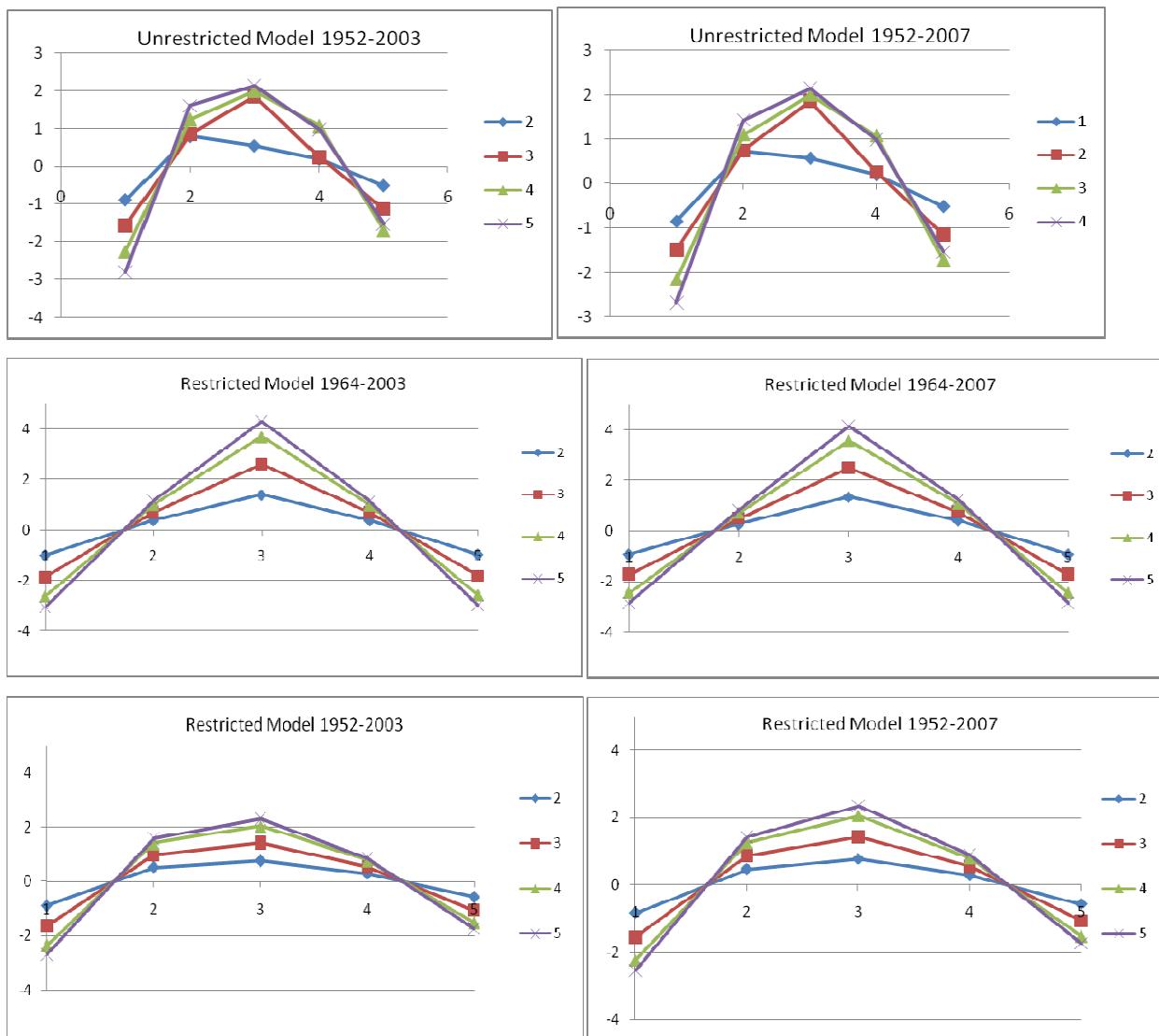


Figure A.1 – CRSP Data Prior to 1964 – Performance on Unrestricted and Restricted Model



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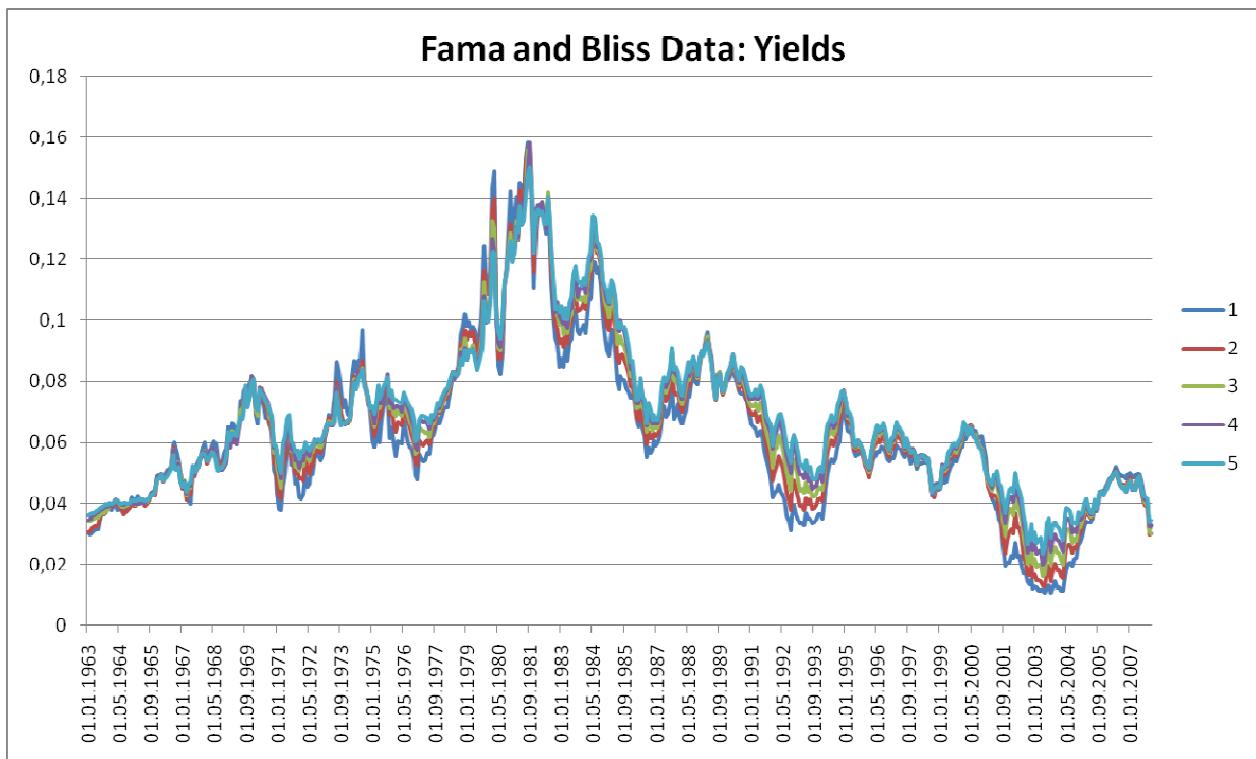
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Figure A. Fama and Bliss Data: Yields



## B. Federal Reserve

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Figure A.1 "Federal Reserve Data: Yields on the Federal Reserve Dataset"

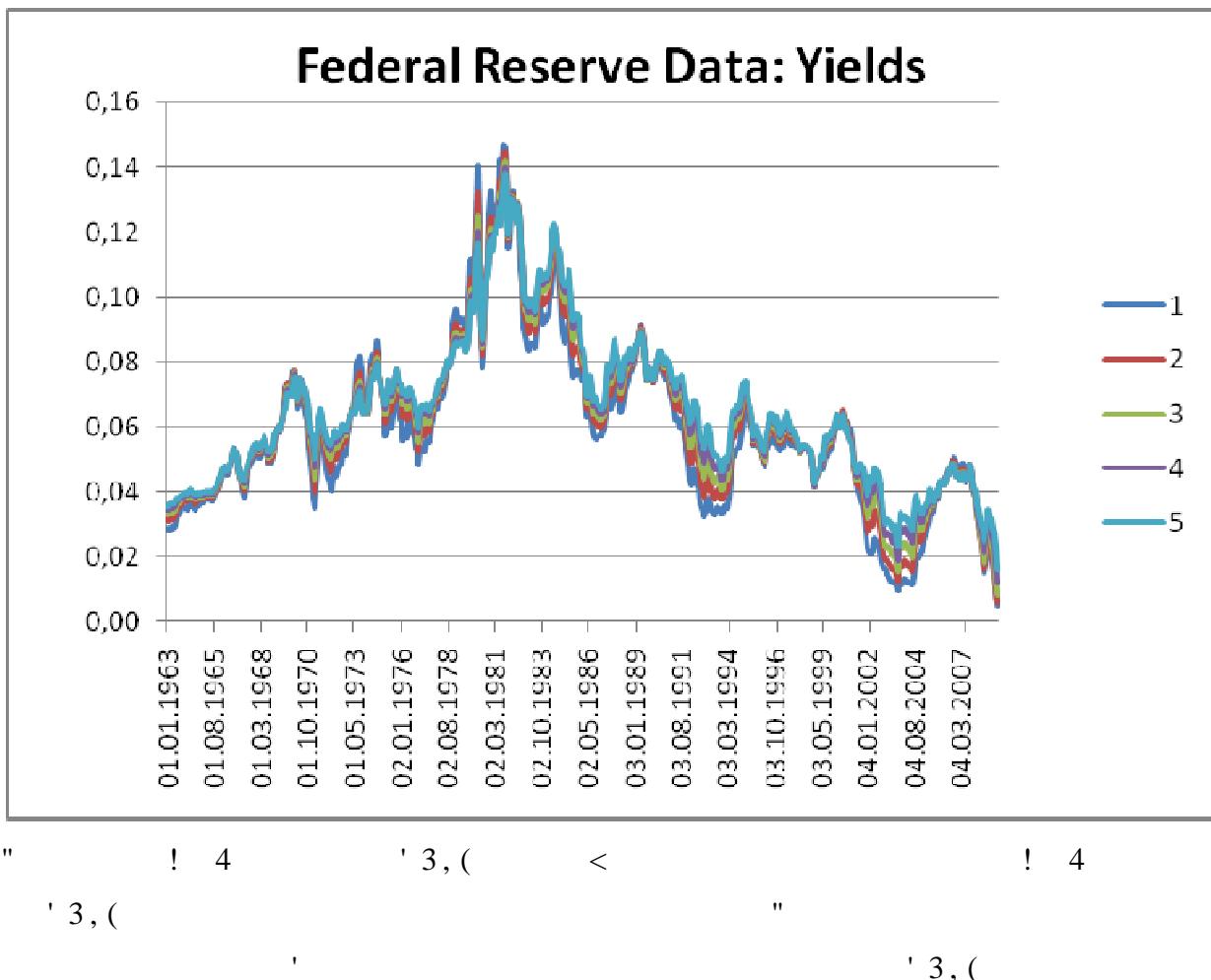
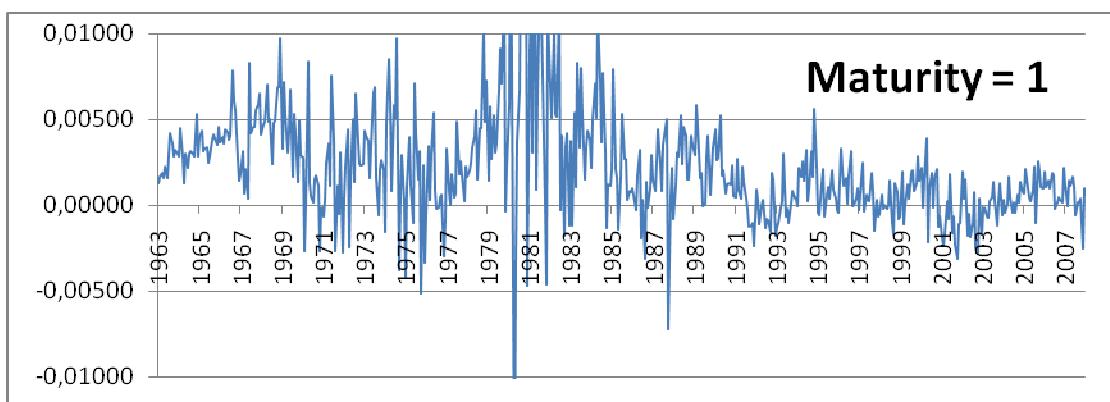
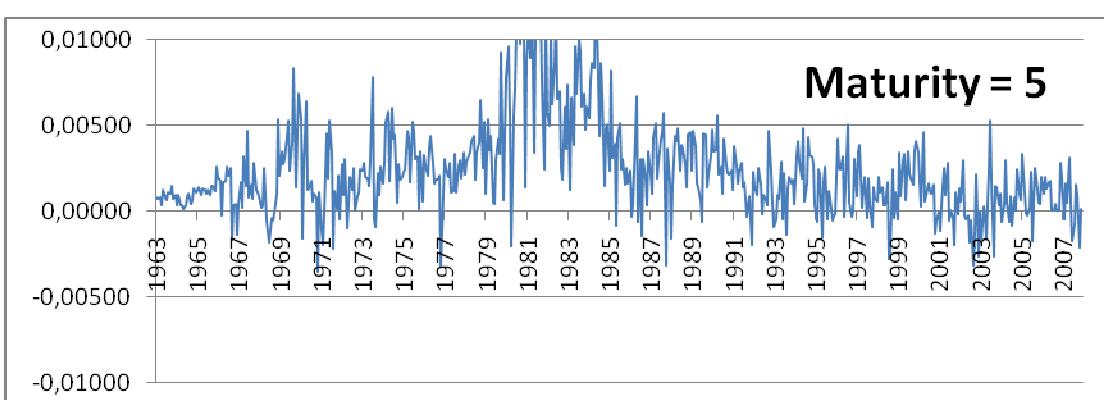
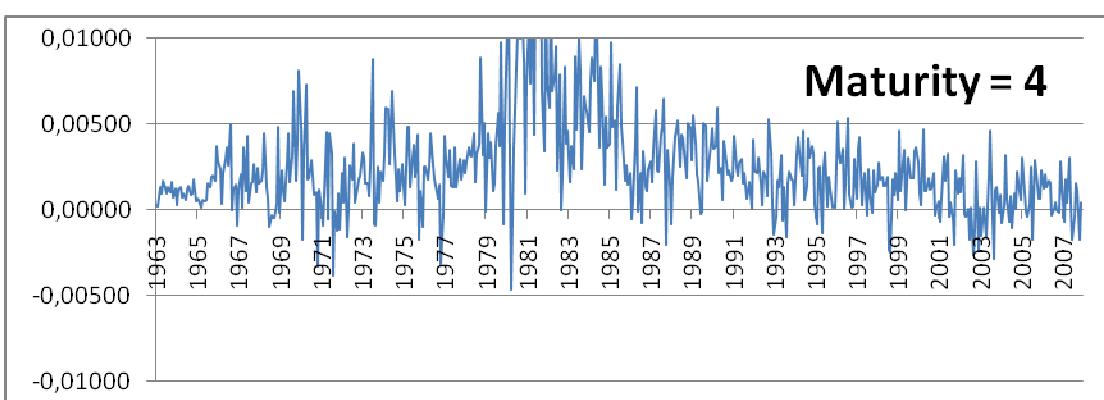
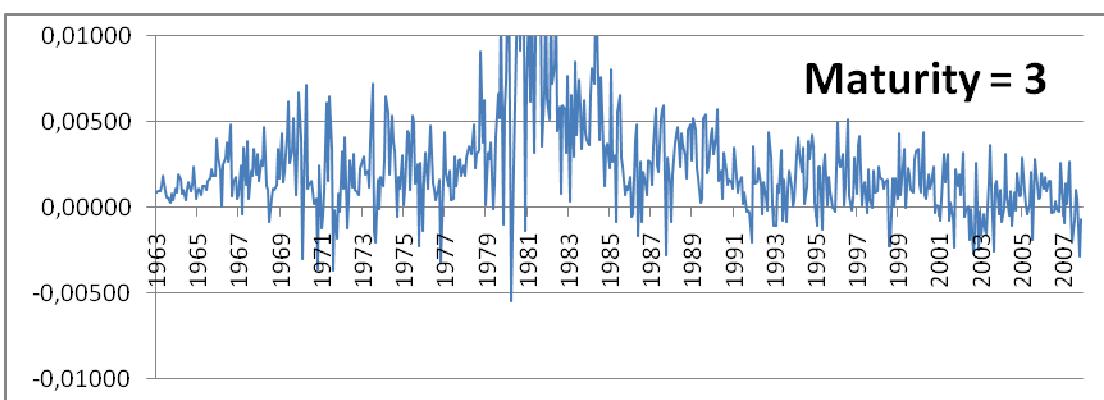
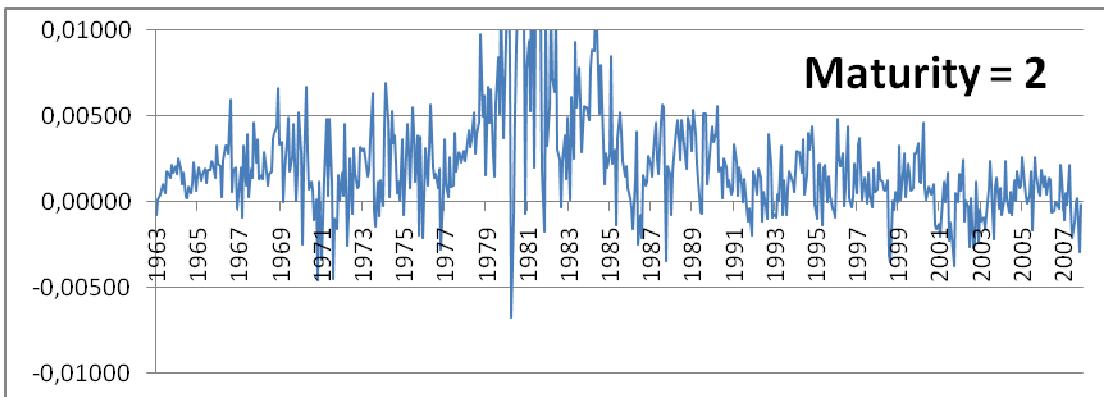


Figure A.4 – (% Difference in Yields) between the Fed and the CRSP Dataset





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### C. Datastream

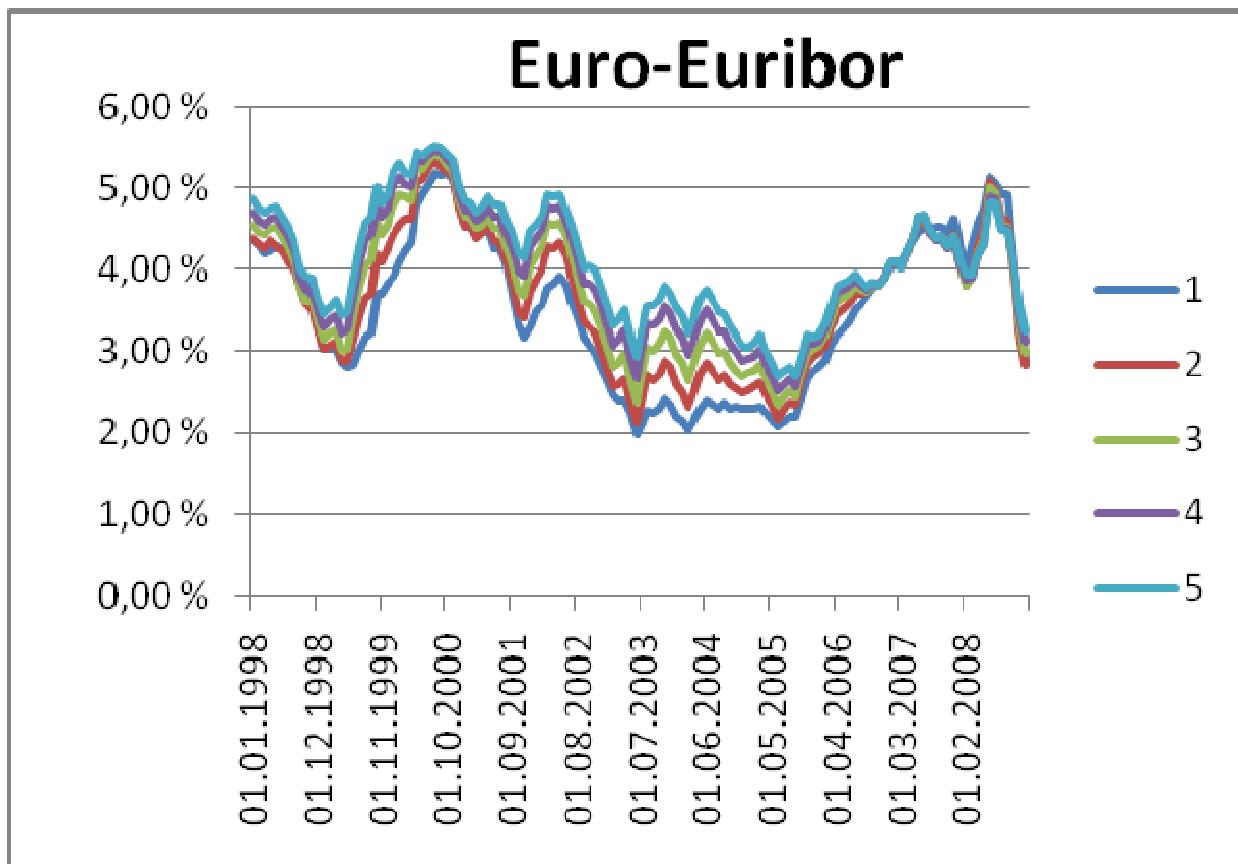
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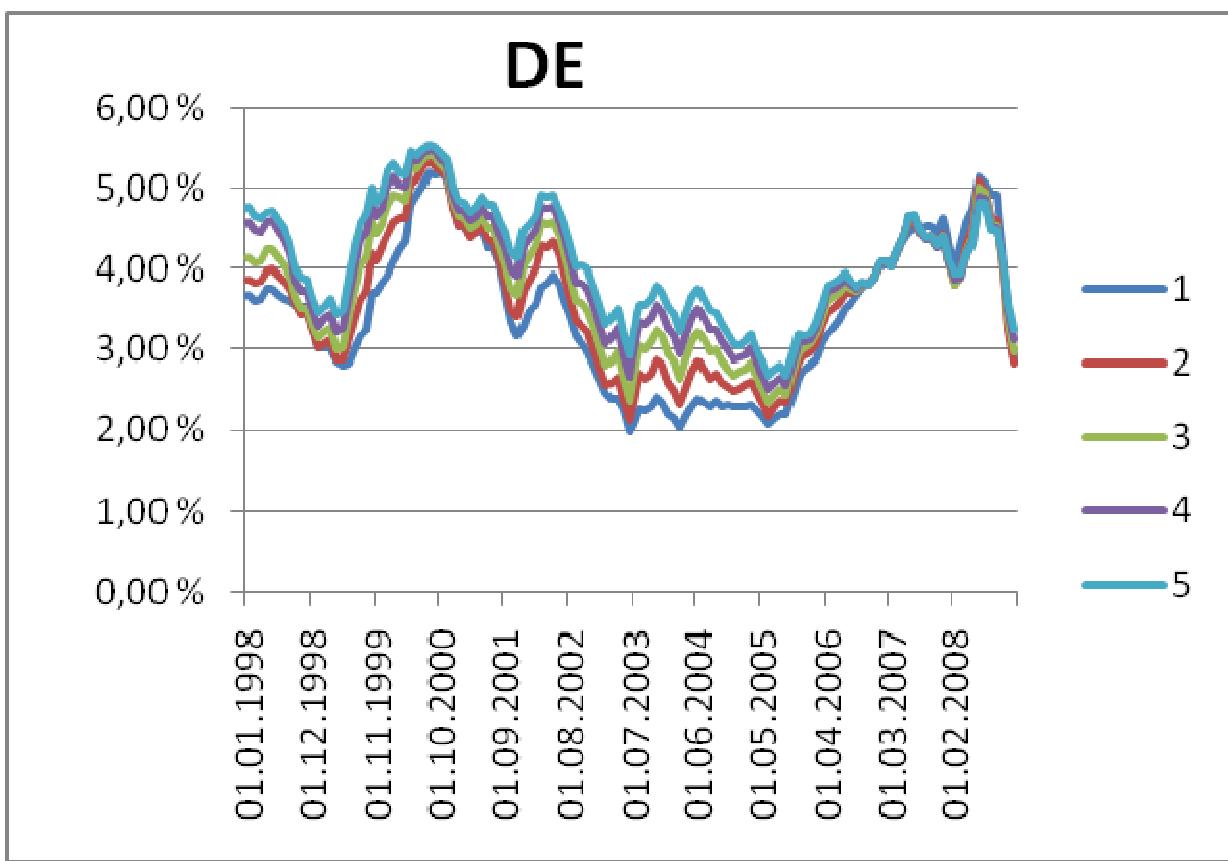
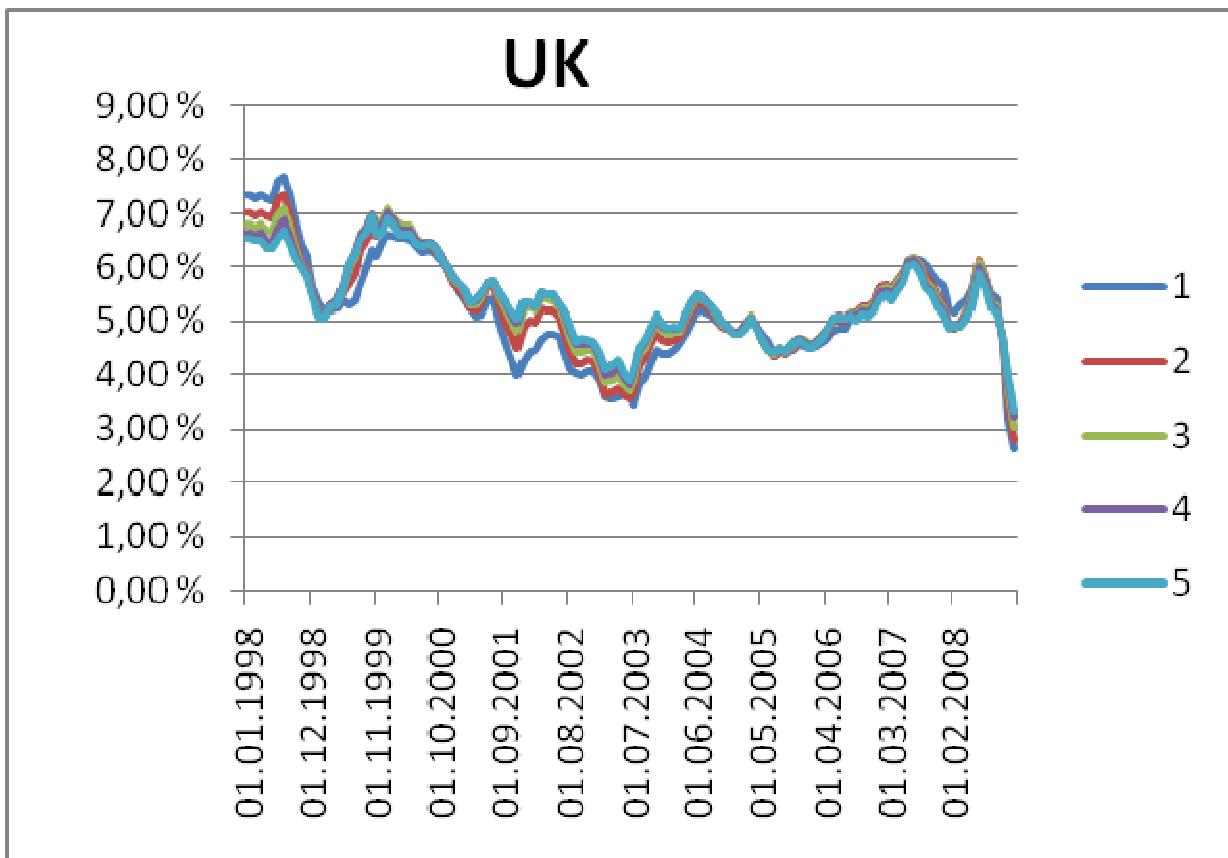
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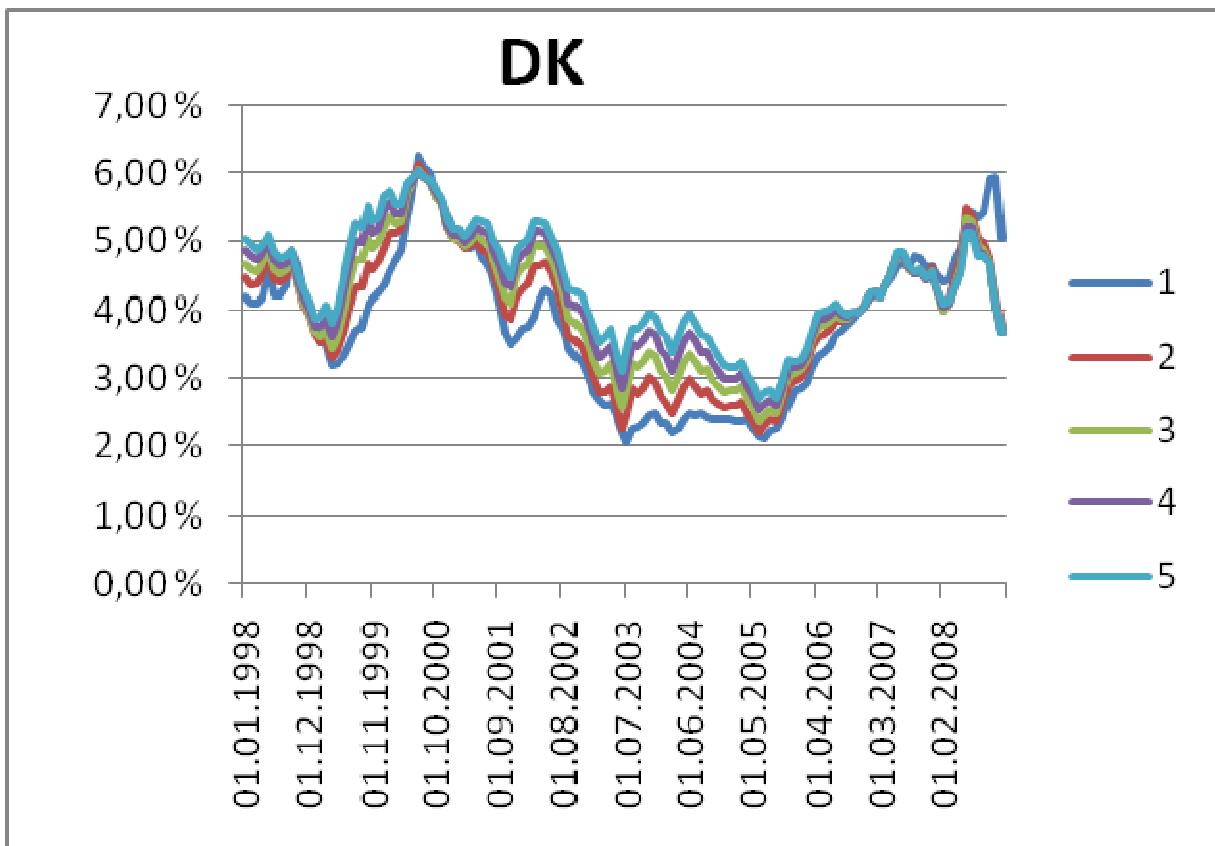
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Figure A.+ ! "ero Cou#on \$ields on t%e Four Datastream Datasets







#### D. Data Transformation and Notation

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Figure A.6 ! Multi#le 1ags 2stimation Procedure – 23cel 45A

Temporary gamma-vector to avoid circular reference				
Lag	0	1	2	3
y0	0,0324	0,0321	0,0318	0,0320
y1	2,14	1,44	2,00	1,01
y2	0,81	1,07	1,33	1,48
y3	3,00	3,03	3,47	3,30
y4	0,80	1,13	1,70	2,17
y5	2,05	3,11	3,02	3,95
R-squared	0,35	0,41	0,43	0,44
Sum checksum				
int convergence:				
convergence				
True				
Lags	0	1	2	3
a0	1,00	0,50	0,00	0,01
a1		0,50	0,05	0,29
a2			0,00	0,29
a3				0,21
Normalized	1,00	1,00	1,00	1,00
	0,50	0,50		
	0,05	0,05	0,00	
	0,21	0,21	0,21	
Run				
Checksum				
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Appendix 4 \* Errors in Co\$' rane and Pia55esi 6! 7789

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## Appendix : – Numerical Results

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### A. CRSP; $1 \leq \epsilon^* \leq 774$

#### (unrestricted) coefficients and standard errors

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(	#"-6	#1= /	!-()	(-	!-/	#1-/6	11(-/!	!=4
4	#(=/!	#"-	!/	(-61	1=/	#"- (	11-= "	!=()
-	#4-/9	#(="1	1="4	4=11	1="-	#"-/(	//=16	!=(-
. e, e8 Test								
"	!-6"	!-16	!-(	!-(!	!=""	!-"		
(	1=14	!-9	!-6"	!-!	!-41	!-6		
4	1=-6	!-41	!-/1	!-6-	!--	!-49		
-	1=94	!-"	!-9/	!- /	!-6	!-6"		
Oansen#OodricG								
"	!-69	!-1	!-4!	!-9	!=""	!-1		
(	1="	!-(!	!-6	!-4	!-41	!-()		
4	1= (	!-44	!-/	!-9	!--	!-4!		
-	"-16	!---	1- (	!-6	!-6-	!-49		

T\*val%es or T' e +/pot% esis T' at Ea\$% (unrestricted Coefficients t% e Restricted Counterpart

Maturity	, -/012			
	"	(	4	-
Const	!-1	#!-1	#!-"	!-"
B1E	!-!	#!-"	#!-"	!-4
fD'E	#!-(	!-"	!-"	#!-1
fD(E)	!-(	#!-9	!-"	!-(
fD4E	!-"	!-	#!-6	#!-"
fD-E	#!-"	!-1	!-4	#!-(

## Restricted \$oe \$ients#R!#2! and standard errors

		Standard Errors				
	Estimates	OOLags	. e, est 1/5ags	OOSimplified Lags	. o 2)erla	
H!	#(-4	1=4-	1=(1	1=/!	1=/()	
H1	#"=4	!=6	!=(4	!=9	!=4	
H"	!=1	!=4	!=69	!=4	1=69	
H(	(-!	!=!	!=--	!= /	1=69	
H4	!=!	!=4-	!=46	!=6"	1="1	
H-	#"!= /	!=4	!=41	!=--	1=6	
OOL-E		/11="9	1!=4	4"=41	""--	
R"	!=(-					

## Expected return after ?@

E2,34., 15 67	
C892,	0,0#
:%&	2,(
:%2&	' ,#8
:%#&	6,60
:% &	11,51
:%5&	10,#8

## Principal Component Analysis; Aield Factors

B1., V1;, 8-2	5engt'	: ar	2rt' onogalit8
5e)el	!=466!/"6 !=4-9/!4!9 !=4449/-// !=4(-6-44- !=4" 6"-4 1=!!!!!(4 !=!!(!"- (6		
Slope	#= (9919! - #=19/"9 !=1(! - /1 !=(661! - ( !=119946( 1=!!!!!( 4- "9441#! - #(=! ("91#1"		
Curvature	!=4 !("(( - !=6"19-61 !=(91/9(1" !=99/9/4 !=4/16-1!4 !=999999/4 1=" //1#16 "#=664-1#1- #1=96 91#14		
5e)el	!=964!1169 !=99- 6166 !=99 -- " !=9//9/-99 !=9 /46!61 9/-! J 9/-! J	Average	Cumulative A.g.
Slope	!=6"-6-( !=!" !-1 !=!1"/6(" !=1!4--19 !=!"99 16 1=44 J 99-9(J		
Curvature	!=!!((44 !=!!61/9( !=!!"6"/9 1=1("61# - !=!!4"169 !=!( J 99-9 J		
Sum	1!!=!6 J 99-9" J 99-9( J 99-9- J 99-99 J		

## Slope#-evel and C%rvat%re Re)ressions

	6amma	. e, est 1/5ags	OOSimplified
Const	#!=!(	1=(1	1=/!
Slope	(=9/	1="4	"=! -
8D'E	#(-6!	"=1/	(=1/
8D(E	6!= /	"=(9	(=()
8D4E	1!=! -	"=46	(=()
8D-E	#1"=4"	"=(4	(="1
C' i\$Fuare D4E		6"=1	"(=1
R sFuared # ste%		!=""	

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
Const	#!=! (	1=(1	1=/!
5e)el	#16=-4	(=1"	4=/
Slo%e	#6=46	1=6	"="9
8D(E	1=94	"=-/	(= 9
8D4E	14=!/	(=4	4=6/
8D-E	"1=! /	(=1	--! 4
C' i#sFuare D(E		(6=9	"!=-
R sFuaed #		!=!"4	

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
Const	#!=! (	1=(1	1=/!
5e)el	(9=--	=/4	1!=4
Slo%e	#4="()	1=(()	1=/4
Cur)e	-"=16	9=4"	1"=4
8D(E	#---/-	1!=!"4	1(-69
8D4E	#(!=!9	=6!	1!=!9
C' i#sFuare D"E		("=9-	1!=!
R sFuaed # ste%		!=!"6	

## Simple Spread Re)ressions

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=(1	1=/!
: %5& : %1 &	"=94	!-9"	1=-"
: %2&	#4=(/	"!=!	"=/
: %#&	6=6!	"=41	(=()
: %' &	11=-1	"=6	(=1()
: %5&	#1=(("	"=1	(=-!
C=3 2>0. <1 % &		/--	(!=!"
R 2>0.<15		!=1 -	

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=(1	1=/!
: %1 &	"=94	!-9"	1=-"
: %5&	#1!=/	"!=	"= 6
: %2&	#4=(/	"!=!	"=/
: %#&	6=6!	"=41	(=()
: %' &	11=-1	"=6	(=1()
C=3 2>0. <1 %#&		4=	"=46
R 2>0.<15		!=""	

C892,	6gamma	. e, e8#7 est 1/ 5ags	OO Sim%lified
: %&	#!=! (	1=(1	1=/!
: % &	#"=94	!-9"	1=- "
: %5&	11-1	"=(6	(=1(
: %2&	#1!=()	"=!	"= 6
: %#&	#4=(/	"=!!	"=/
C=3 2>0.<1 %2&	6-6!	"=41	(=(
R 2>0.<15		9=1	4=6
		!=((	

## N%mBer o " at%rities

n	61	62	6#	6'	65
n K 1		!=11			
n K "	#=""44!/1"	"=6 6(!""			
n K (	#1=6 /16- "1	!=1"! ("(16	"=! -! -96"6		
n K 4	#1=-16- 1/4	#!=199-19(	1= 46/1644	!=4/"!!466	
n K -	#"=1(-"-(-	!=!/ (1/(	(=!!6(/-	!=/!1" 999	#"=! - ! /

## Prin\$ipal Component Anal/sis o Expe\$ted Ret%rn

Covariance Matrix											
N-1	0,0001198	0,00022199	0,0003205	0,00038011							
	0,00022199	0,00042545	0,00060971	0,00072034							
	0,0003205	0,00060971	0,00088984	0,0010491							
	0,00038011	0,00072034	0,0010491	0,00124501							
Var	0,0001198	0,00042545	0,00088984	0,00124501	0						
Beta Vectors					Length	Var	Orthonogality				
1	0,21	0,40	0,58	0,68	1,0000000000000000	0,002666951					
2	0,27	0,84	-0,16	-0,44	1,0000000999	6,77941E-06	1,1792E-12				
3	0,64	-0,11	-0,64	0,41	1,0000000855	3,96266E-06	2,9454E-12	8,4262E-12			
4	-0,69	0,34	-0,48	0,42	1,000000001	2,41391E-06	-4,2188E-15	-2,72E-15	-7,383E-15		
Error in article:	3rd and 4th component exchanged										
	0,00011654				Average		Cumulative Avg.				
1	0,97280242	0,98787518	0,99735475	0,99808412		98,90 %	98,90 %	<-- differs from article			
2	0,0040313	0,01134429	0,00019466	0,0010416		0,42 %	99,32 %	due to the search process			
3	0,01362001	0,00011713	0,00181915	0,00053203		0,40 %	99,72 %	that finds the eigenvalues			
4	0,00953657	0,00066896	0,00063254	0,00034051		0,28 %	99,999881 %				
Sum	99,9990 %	100,0006 %	100,0001 %	99,9998 %							

)

## B. CRSP; 1<=: \*! 77C

### (nrestric\$ed \$oe i\$ients#R!#2! and standard errors)

Maturit8	Const	8D1E	fD"E	fD(E	fD4E	fD-E	C' i#sFuare D-E	R sFuaed
"	#1- #"-49 #(-44 #4(6	#!-9! #1-6- #"-4! #(-1	!-46 !-C" !-61 !-9(	1=1/ "-99 (-4/ (-9(	!-( !-4- 1-(6 1-(4	#!-/4 #1= / #"-6(	1!9-11 1!4-/ 1!6-! 9-9"	!-C" !-CC !-6 !-( !
. e, e8 Test								
"	!- -	!-16	!-(-	!-(1	!-!"	!-!"		
(	1=1	!-9	!-	!-1	!-(9	!-(-		
4	1=4!	!-41	!- "	!-66	!-"	!-4/		
-	1= -	!- -!	!-/6	!- /	!-6(	!-6!		
Oansen#OodricG								
"	!-6!	!-1	!-(/	!-(1	!-!"	!-19		
(	1=-( 1=/( 1=/-	!-(1 !-44 !-"/	!- " !-9" !- --	!-49 !-6" !- 1	!-4(	!-4		
4								
-								

T\*val%es or T' e +/pot' esis T' at Ea\$' (nrestric\$ed Coe i\$ient E>%als t' e Restri\$ed Co%nterpart

Maturit8	, -. /012			
	"	(	4	-
Const	!-!	!-!	!-!	!-!
8D1E	!-!	#!-1	!-!	!-!
fD"E	#!- #!-	!- !-(	!-1	#!-"
fD(E	!- !-	#1-!	!-!	!-"
fD4E	!-"	!- !-"	#!-6	#!-"
fD-E	#!-"	!-" !-"	!- !-	#!- #!-()

### Restri\$ed \$oe i\$ients#R!#2! and standard errors

	1stimates	Standard 1rrors				
		OO 1"5ags	. e, e8#7 est 1/5ags	OO Sim%lified 1"5ags	. o 2)erla%	
H!	#"-99	1=1	1=1	1-6!	1-6"	
H1	#1-9(	!-(-	!-(4	!- -	!- 9	
H"	!- -	!-6-	!-6(	1-! "	1- -	
H(	"-/( 1-//	!- -"	!- -	!- =	1-64	
H4	!- //	!-4(	!-44	!- -9	1-16	
H-	#1-96	!-(4	!-41	!- -4	1-!!	
fD-E		4/6=()	/9=!	4!- -()	""-99	
R"	!-CC					

## Expe\$ted ret%rn a\$tor ?@

E2,34 . ,15 67	
C892,	2,(6
: %! &	2,57
: %2&	',6#
: %#&	6,0(
: % &	11,'1
: %5&	(,(2

## Prin\$ipal Component Anal/sis; Aield Fa\$tors

B1., V1.;8<	5engt'	: ar	2rt' onogalit8
5e)el	!-46/19!!9 !-46! 6((1 !-44- (4/9 !-4(49/6/ !-4"49 "99	1 !-!(69-6 9	
Slo%e	#!= ((/9(-- #!-!"(61- " !-! 16/!1 !-(66"4 9/ !-19 -9 1-!!!!/-	4-9(6/61#! -	(-4/!661#!"
Cur)e	#!-4 14 6/( !-/-"691- !-4"1"91-1 #!= -! "96/ #!= -!-/469 1-!!!!9	1- -(91#!6	# -991(91#!( 4=-6 -1#!(
	A)verage	Cumulati)e A)g.	
5e)el	!-96 9"-6- !-99646!4- !-99/1"(1- !-99!1/9( !-9/!! //1	9/-66 J	9/-66 J
Slo%e	!=!(1 !"- !-!"-6 -4 !-!1!/(- / !-!9( " !-!19/-1/	1="9 J	99-94 J
Cur)e	!=!!!(1"1/ !-!!-11(( !-!!"/(-9 4="/(1#!6 !-!!44!(1	!=!( J	99-9 J
Sum	1!!-! J 99-9- J 99-9- J 99-96 J 1!!-! J		

## Slope#-evel and C%rvat%re Re)ressions

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%plified
Const	#!=!(	1=1/	1=6-
Slo%e	(=!	1=1-	"=! 9
8D"E	#(=9(	"=1!	(=""
8D(E	-=64	"=(-	(="
8D4E	1!=1"	"=-!	(=
8D-E	#11= (	"="()	(="6
C' i#sFuare D4E		66,18	21,"
R sFuaed	!=!"		

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%plified
Const	#!=!4	1="!	1=-
5e)el	#"-!1	!-!	!-1
Slo%e	#"-! !	1="1	1=/6
8D(E	# "-!"	"=1/	"=99
8D4E	-- --	"=-!	(=()
8D-E	6=6	"=44	(=-6
C' i#sFuare D(E		21,80	17,2
R sFuaed # ste%	!=!"(		

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
Const	#!=! (	1=1	1-6!
5e)el	(4=(9	=""	9-1-
Slo%e	#(4	1=""	1-6-
Cur)e	4-=! !	/-/	1!=/-
8D(E	#4 ="	9=19	11-6
8D4E	" = 6	=9	9="!
C' i#Fuare D"E		2(,0(	17,5
R sFuaed		!"=6	

## Simple Spread Re)ressions

	6amma	. e, e8#7 est 1/ 5a	OO Sim%lified
C892,	#!=! (	1=1/	1-6-
: %& : %1 &	"=94	!=/4	1=-4
: %2&	#4=(/	1=9(	"=/9
: %#&	6=6!	"=(6	(=(6
: % &	11=1	"=4"	(=1-
: %5&	#1 (=""	"=(6	(=-4
C=3 2>0.<1 % &		9=-4	(1=(
R 2>0.<15		!=1-	

	6amma	. e, e8#7 est 1/ 5a	OO Sim%lified
C892,	#!=! (	1=1/	1-6-
: %1 &	"=-	!=/4	1=-4
: %5&	#9-9"	"=!" "	"= /
: %2&	#4=6(	1=9(	"=/9
: %#&	6!=9	"=(6	(=(6
: % &	11=41	"=4"	(=1-
C=3 2>0.<1 %#&		41!=	"=""=(
R 2>0.<15		!"=""	

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=1/	1-6-
: %1 &	"=-	!=/4	1=-4
: % &	11=41	"=4"	(=1-
: %5&	#9-9"	"=!" "	"= /
: %2&	#4=6(	1=9(	"=/9
: %#&	6!=9	"=(6	(=(6
C=3 2>0.<1 %2&		/(=	4=(
R 2>0.<15		!=("	

---

## N%mBer o " at%rities

n	61	62	6#	6'	65
n K 1		!=14			
n K "	#"=1((49!-/	"=46(9"49"			
n K (	#1---66 -44	!=!6-(!"49	1-9 99"-4"		
n K 4	#1=4199- 11	#!=1/4!4 "	1= 1!!1(	!=4!1/6--1	
n K -	#1=9//66/-9	!= 9/1 (9	"=/9 !( "-"(	!=/6/119 9	#1=9/(164

## C. Federal Reserve; 1<: \*! 774 6" ont' l/ Avera)e9

### (nrestristed \$oe i\$ients#R!#2! and standard errors1

Maturit8	Const	801E	f0"E	f0(E	f04E	f0-E	C' ifisFuare D-E	R sFuaed
"	#1=""	#1(-	"= "	#(4(	446	#"="1	"6-/4	!"1
(	#"=(	"-6	-="9	#6=(	=6(	#(-9	((-/!	!"(
4	#(4!	#(-9	= !	#9!=	1!=1	#4-46	(9= !	!"-
-	#4-4	#-4 "	9-9!	#11-6	11-1	#4-4	4(-6	!"6
. e, e8 7 est								
"	!=!	!44	444	14-/-	1/94	/=-1		
(	1=()	!= 9	-91	"6!= -	(4! "	1-=()		
4	1=	14	11-66	(-=()	464-	"!=9(		
-	"=(1	1-"	1"-9	4(=/"	- ="(	"-=4		
Oansen#OodricG								
"	!-91	!4	4-9-	16=""	"1!=	94/		
(	1=	!/-	/-(	"9-1	( /	1 -4		
4	"=1"	11	11-91	(9=()	-1= (	"(1		
-	"-6"	144	144/	4/=	6(= /	"/- 9		

T\*val%es or T' e +/pot' esis T' at Ea\$' (nrestristed Coe i\$ient E>%als t' e Restri\$ted Co%nterpart

Maturit8	, -./012			
	"	(	4	-
H!	!=1	!=1	!=1	!=1
H1	!=1	!=1	!=1	!=1
H"	!=1	!=1	!=1	!=1
H(	!=1	!=1	!=1	!=1
H4	!=()	!=()	!=1	!=
H-	!=()	!="	!=1	!=6

### Restri\$ted \$oe i\$ients#R!#2! and standard errors

		Standard 1rrors				
	1stimates	OO 1"5ags	. e, e8#7 est 1/5ags	OO Sim%lified 1"5ags	. o 2)erla%	
H!	#"/-	1-/!	1-9	1-94	"-! "	
H1	#(-4	!9/	!-9!	1-!"	1-/	
H"	6-4!	1!-!!	/-96	/-!4	1--1	
H(	# -4	((11	"9- 1	"4-9"	46-9	
H4	/-(	4(-4/	(9-4	("-!9	-/-4!	
H-	#(-6/	19-6!	1 -9	14-4!	"-4/	
I" D-E		(6-4	(/-	1/="	1"=	
R"	!" -					

## Expe\$ted ret%rn a\$tor ?@

E2,34. ,15 67	
C892,	2,85
: %&	(,6'
: %2&	27,75
: %#&	' 7,52
: % &	' 8,20
: %5&	18,' 1

## Prin\$ipal Component Anal/sis; Aield Fa\$tors

	Sengt'	:ar	2rt" onogalit8
5e)el	!-4 /-4" ( !-4-9! 1 9( !-4444119/ !-4("6 " / !-4""4! 1!/ 1=!!!!!!/4/ !-!"- /((		
Slo%e	#= "-"1//1 #="!4-94 1 !-1"/11 /4 !-6(!94! - !-("6 91 1=!!!!!!994 (-4"6 91#! - #1-(4!41#1"		
Cur)ature	#-4 ! - (1 !---444// !-44(61 -( #!-1 (1-6 #!-"" 9 1 1=!!!!!!- 6=4!/61#! 4-/11 1#14 " 61 1#14		
	A)erage	Cumulati)e A)g.	
5e)el	!-9 !-441 !-996/-9"" !-99/6! 194 !-99!4! 61 !-9 /- 94 9/= ! J 9/= ! J		
Slo%e	!-! "996! / !-! "6("16 !-! 11! ( !-! 9"/(14 !-! "69/"4 1=" J 99-9 J		
Cur)e	!-! !!!!!-4 !-! !(4199 !-! !(1( (= "1 1#! !-! !(-! -" !!" J 1!!4! J		
Sum	11!= J 99-9/ J 99-99 J 99-9 J 99-96 J		

## Slope#-evel and C%rvat%re Re)ressions

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
Const	#!=! (	1=-9	1-94
Slo%e	1(="9	1(-4(	1"-4"
8D"E	(!-4	9-6	6 = "
8D(E	#49=""	"! =1	1 1=46
8D4E	4(=/	""1= 1	1/1=6
8D-E	#"-=!	94=(1	=!"
C' ifsfuare D4E		6= /	4-9
R sFuaed # ste%		!=!"	

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
Const	#!=! (	1=-9	1-94
5e)el	#( (=-!	1""=1 -	99-99
Slo%e	#/=(/	6/=9	-6=14
8D(E	41="!	11/16	9/46
8D4E	#(1=	14(=	1"!-4-
8D-E	6-="	(! (=4	"4/=-
C' ifsfuare D(E		6=9	(=
R sFuaed #		!=!"	

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
Const	#!=! (	1=9	1=94
5e)el	114=1	--9=1"	4-/!=!"
Slo%e	(=""	16=1	14=-1
Cur)e	1(!= -	6!-= (	496=! -
8D(E	#96=--	-""=1"	4" --1
8D4E	#1-6=61	19= 9	-9!-= (
C' i#sFuare D'E		!=1	!="
R sFuaed #ste%		!="-	

## Simple Spread Re)ressions

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=9	1=94
: %& : %1&	9=64	9= 4	9!=1
: %2&	" = -	6=9/	6-="9
: %#&	#4 =-"	"! --4	1 != -
: %' &	4/="!	""6=1(	1/-=(6
: %5&	#"/!= -	96=6(	9=1(
C=3 2>0.<1 % &		1!=4	/=9
R 2>0.<15		!=14	
	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=9	1=94
: %1&	#9=64	9= 4	9!=1
: %5&	#1/-41	/ =96	"!=!
: %2&	" = -	6=9/	6-="9
: %#&	#4 =-"	"! --4	1 != -
: %' &	4/="!	""6=1(	1/-=(6
C=3 2>0.<1 %#&		6=9	(=
R 2>0.<15		!=1	

	6amma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=9	1=94
: %1&	#9=64	9= 4	9!=1
: %' &	4/="!	""6=1(	1/-=(6
: %5&	#1/-41	/ =96	"!=!
: %2&	" = -	6=9/	6-="9
: %#&	#4 =-"	"! --4	1 != -
C=3 2>0.<1 %2&		!9	!=
R 2>0.<15		!=4	

## N%mBer o " at%rities

n	61	62	6#	6'	65
n K 1		!-! /			
n K "		#"-64	(=! 6		
n K (		#(=! /	4=- (	#1=!	
n K 4		#(=! /	4=-	#1=1 -	!=! -
n K -		#("4	6=4!	# =4	/=(
					#(=6/

## Prin\$ipal Components Anal/sis o Expe\$ted Ret%rn

C8-.3.9;1M.,<3

N 1

```
6-(6-1#! - !=!!1"114 !=!!1 " /4 !=!!"!!"
!=!!1"1!4 !=!!"(194 !=!!(( " !=!!4"4/
!=!!1 " /4 !=!!(( " !=!!4 /-- !=!!61""(
!=!!"!!" !=!!4"4/ !=!!61""( !=!! /44"
```

:ar

```
6-(6-1#! - !=!!"(194 !=!!4 /-- !=!! /44"
```

!

B1,. V1;8-2

1	!=!"	!=!(9	!=--	!= 1
"	!=6	!=="	!=	#!=()
(	!=64	!=!(1	!=--6	!=4()
4	!=!(	!= !	!=61	!=19

1rror in article! (rd and 4t' com\$ponent e;c' anged

5engt'

:ar

2rt' onogalit8

1=!!!!!!-!	!=!!1---6((
1=!!!!!! 6	"// 1(1#16 #1(( /1#14
1=!!!!!!("	4/19 11#/ /#/-1-41#14 (=/"6/1#1(
1=!!!!!!"	1=(1(11#19 1=11! "1#16 1=(/ /1#1 #/="6 1#1

Sum

"-!	(-!	4-!	-=!	Average	Cumulati)e A)g.
1 != 9 9-1! (" != 9966-6( != 99969 - != 99/9"614	99=( 6-6 J	99=( 6-6 J			
" != "!" "9-1 != !(6/( ( != -441#! - != 11!"(/	!=616(( J	99-99"/9 J			
( != !(16/ 1!= -41#! - ( != 11/1#! - 1!= "(11#! -	!= !9"4 J	1!= !1"1(( J			
4 != "(9"1#! 6 != -491#! 6 1!= /(1#! 6 != 1-1#! /	!= !1- J	1!= !1" / J			
11!= 149 J 11!= 14 J 11!= (4 J 99-9961 J					

D . Federal Reserve; 1<=: \*! 774 6End o " ont' 9  
 (nrestric\$ted \$oe i\$ients#R!#2! and standard errors1

Maturit8	Const	8D1E	fD'E	fD(E)	fD4E	fD-E	C' if'sFuare D-E	R sFuared
"	#1="6	#1=( "	"="6	#1=" "	1=-4	#!=	"(=-(	!=!"
(	#"=(-	#"-9	4="!	#"= "	"=44	#1="1	"9=1"	!=()
4	#(=41	#(= /	6=(!	#4=41	4=11	#1= /	(4=	!="-
-	#4=46	#4=9"	/=4!	#6=1	4=99	#1=	(9=4"	!=6
. e, e8 7 est								
"	!= /	!= /	(=19	1!=6	1=(	6=!		
(	1=(6	!6/	-6"	1/=1	"(=6-	1!=6/		
4	1=/-	!91	4	"4=(6	(1=9!	14=46		
-	"=9	1=!	9=!	"9=6	(9!=!	1 = (		
Oansen#OodricG								
"	!=//	!=1	(= "	11=4"	14=	6=6		
(	1=4	!= (	6=1	"!=4	"6!=9	11=1		
4	"=1!	!9	/=1/	"6= 6	(-=16	1=9/		
-	"=6!	1=1/	9=1	("=41	4=94	19=-/		

T\*val%es or T' e +/pot' esis T' at Ea\$' (nrestric\$ted Coe i\$ient E>%als t' e Restri\$ted Co%nterpart

Maturit8	, -./012			
	"	(	4	-
H!	!=	!=1	!=!	!=1
H1	!=1	!=1	!=!	!=1
H"	!=1	!= "	!=!	!=()
H(	!=1	!= (	!=!	!=4
H4	!=!	!= "	!=1	!=1
H-	!=1	!=!	!=1	!="

Restri\$ted \$oe i\$ients#R!#2! and standard errors

		Standard 1rrors				
	1stimates	OO 1"5ags	. e, e8#7 est 1/5ags	OO Sim%lified 1"5ags	. o 2)erla%	
H!	#"/	1=	1=-6	1=9-	1=96	
H1	#(=1-	!=/"	!= 6	1!=	1=6	
H"	--=9	6=9!	6=(!	6=1(	11=4!	
H(	#(=66	""=--/	"!=--	1/=94	(-=!(	
H4	(="	"9=64	"6=/	"4= "	44=4!	
H-	#1=(/	1(=46	1"=1/	11="9	19=61	
I" D-E		(!=	((=6	1/=1	1"=	
R"	!=4					

### (a)le 14 in main te3t

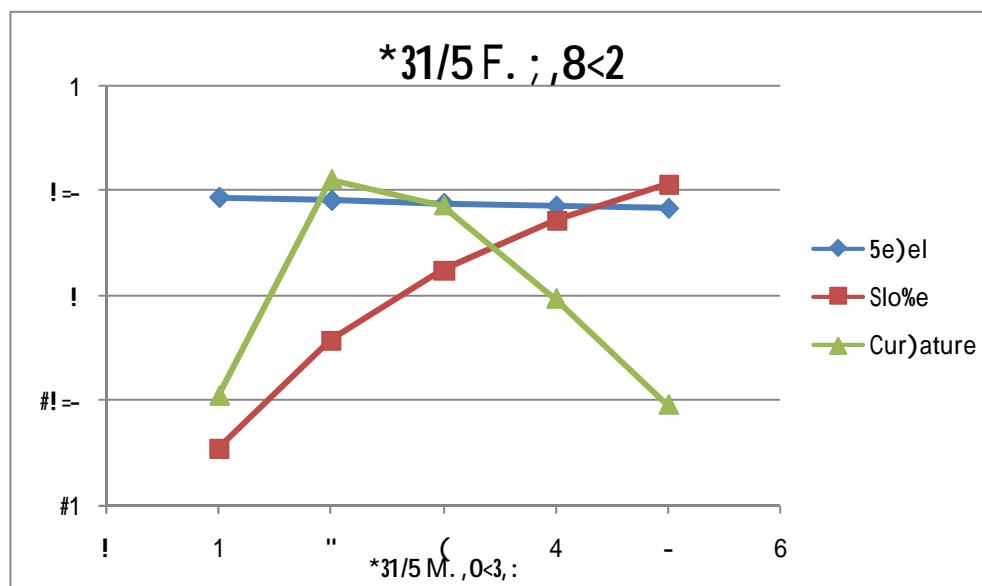
n	$b_n$	R''	Unrestricted R''
"	!-46	!=19	!=!"!
(	!/-	!="(	!="(
4	1=19	!="-	!="-
-	1=-!	!="6	!="6

### Expe\$ted ret%rn a\$tor ?@

E2,34., 15 67	
C892,	2,87
: %1&	8, ''
: %2&	17,(0
: %3&	20,78
: %4 &	18,61
: %5&	6,(2

### Prin\$ipal Component Anal/sis; Aield Fa\$tors

B1., V1;, 8<2	5engt'	ar	2rt' onogalit8
5e)el	!-4 -/-4"( !-4-9!1 9( !-4444119/ !-4("6 " / !-4""4!1!/ 1=!!!!!!4/ !-!"- /((		
Slo%	#!= "-1//1 #!=!4-94 1 !-1"/11 /4 !=6(!94!- !-("6 91 1=!!!!!!994 (=4"6 91#! - #1-(4!41#1"		
Cur)ature	#!-4 ! -1( !---444// !-44(61 -( #!-1 (1-6 #!-"" 9 1 1=!!!!!!- 6=4! /61#! 4=/1 1#14 "= 61 1#14		
	A)erage	Cumulati)e A)g.	
5e)el	!-9 !-441 !-996/-9"" !-99/6!194 !-99!4!61 !-9 /- 94 9/= ! J 9/= ! J		
Slo%	!-!996! / !-!6("16 !-!!11!( ! ( !-!9"/(14 !-!69"/4 1=" J 99-9 J		
Cur)e	!-!!"""-4 !-!!(4199 !-!!"((1( (= "1 1#! !-!!(-!-! " !" J 1!!-! J		
Sum	1!!-! J 99-9/ J 99-99 J 99-9 J 99-96 J		



### Slope#-evel and C%rvat%re Re)ressions

\*)

	6amma	. e, e8#7 est 1/ 5ags	00 Sim%lified
Const	#!=! (	1=-6	1=9-
Slope	11=6/	9=-1	9=61
8D"E	"!=6	--="	-1=44
8D(E	#""="6	14"=/4	1(1=1/
8D4E	14=(	1-"/1	14!= "
8D-E	#1(=1-	6-=1	6!=(-
C' i#sFuare D4E		=9	--
R sFuaed # ste%		!=19	

	6amma	. e, e8#7 est 1/ 5ags	00 Sim%lified
Const	#!=! (	1=-6	1=9-
5e)el	#1 =! 1	/4=4/	/!=
Slope	!= " "	4 ="-	44=1(
8D(E	"-=/(	/1=4/	-!=4
8D4E	#1(="/	99=(-	91=6-
8D-E	"-= 9	"!9=(	19"=91
C' i#sFuare D(E		=!	(=
R sFuaed #		!=1	

	6amma	. e, e8#7 est 1/ 5ags	00 Sim%lified
Const	#!=! (	1=-6	1=9-
5e)el	4!=1	(/=""= 1	(-=""=-!
Slope	4=61	14=/	14=/(
Cur)e	-1!=1	414=19	(/1=6(
8D(E	""/=(	(-9= 4	((=""= 1
8D4E	#61=-/	4/9=4	449=91
C' i#sFuare D"E		!=()	!="
R sFuaed # ste%		!=4	

## Simple Spread Re)ressions

	6gamma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=9	1=94
: %& : %1 &	9=64	9= 4	9!= 1
: %2 &	" = -	6=9/	6-= "9
: %# &	#4 =- "	"! --4	1 != -
: %' &	4/=!"!	""6=1 (	1/-=(6
: %5 &	#"/!= -	96=6(	9=1 (
C=3 2>0. <1 % &		1!=4	/=9
R 2>0. <15		!=14	
	6gamma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=9	1=94
: %1 &	9=64	9= 4	9!= 1
: %5 &	#1/-41	/ =96	"!= !
: %2 &	" = -	6=9/	6-= "9
: %# &	#4 =- "	"! --4	1 != -
: %' &	4/=!"!	""6=1 (	1/-=(6
C=3 2>0. <1 %# &		6=9	(=
R 2>0. <15		!=1	
	6gamma	. e, e8#7 est 1/ 5ags	OO Sim%lified
C892,	#!=! (	1=9	1=94
: %1 &	9=64	9= 4	9!= 1
: %5 &	4/=!"!	""6=1 (	1/-=(6
: %2 &	#1/-41	/ =96	"!= !
: %# &	" = -	6=9/	6-= "9
: %' &	#4 =- "	"! --4	1 != -
C=3 2>0. <1 %2 &		1!=9	!=
R 2>0. <15		!=4	

## N%mBer o " at%rities

n	61	62	6#	6'	65
n K 1	!=! /				
n K "	#"-64	(!= 6			
n K (	#(-! /	4=- (	#1!=		
n K 4	#(-! /	4=-	#1=1 -	!=! -	
n K -	#(-"4	6=4!	# =4	/=(	#(-6/

## Prin\$ipal Components Anal/sis o Expe\$ted Ret%rn

C8-.3.9;1 M.,<3

N 1

6=(6-1#! - !=!!1"1!4 !=!!1 " /4 !=!!"!!"
!-!!1"1!4 !=!!"(194 !=!!(( " !=!!4"4/
!-!!1 "/4 !=!!(( " !=!!4 /-- !=!!61""(
!-!!"!!" !=!!4"4/ !=!!61""( !=!! /44"

:ar

6=(6-1#! - !=!!"(194 !=!!4 /-- !=!! /44"

!

B1,. V1;,8<2

1 !="!	!=9	!=--	!= 1
" !-6	!= "	!=	#!=()
( !-64	#!=(1	#!-6	!4(
4 #!=()	!= !	#!-61	!=19

1rror in article6 (rd and 4t' com%ponent e;c' anged

"-!	(-!	4-!	-=!
1 !-9 9-1(" !-9966-6( !-99969 - !-99/9"614			
" !-!"!"9-1 !=!(6/( (4-441#! - !-!!"(/			
( !-!!(16/ 1-9(-41#! - (4"11/1#! - 1"1"(11#! -			
4 ="(9"1#!6 "=-491#!6 1-!(1#!6 -9!1-1#!/			
Sum 1!!-!49 J 1!!-!4 J 1!!-!4(4 J 99-9961 J			

5engt'

1=!!!!!!-!	!=!!1---6((
1=!!!!!! 6	"/=// 1(1#!6 #1(( /1#14
1=!!!!!!("	4/19 11#/ /#=1-41#14 (=/6/1#1(
1=!!!!!!"	1=(1! (11#!9 1=11"1#16 1=(/ /1#1 #/=(6 1#1

:ar

2rt' onogalit8

A)erage	Cumulati)e A)g.
99(- 6-6 J	99(- 6-6 J
!-616(( J	99-99"/9 J
!=!9"4 J	1!!-!1( J
!=!!1- J	1!!-!""/ J

## E. Datastream; 1<<1\*! 77C

### (nrestric\$ed \$oe i\$ients#R!#2! and standard errors)

EURO

Maturit8	Const	8D1E	fD"E	fD(E	fD4E	fD-E	C' i#sFuare D-E	R sFuared
"	#(-46	#!=!4	#!=/(	(-4!	#-69	(-9!	1"-9"	!4"
(	#6-6	#!=()	#"-4	/-4	#9-"	-1(	1/	!4"
4	#/-4/	#!=()	#(-4(	11-1(	#1!-6/	-=-/	"6-9	!4"
-	#1="9	#1=	#4=14	14="1	#1(-1	6-49	46="1	!4"

. e, e8 Test

"	1((="	1!-91	1!9=/	""9=	119=1	(9-6
(	"4!-94	"!=/6	199-14	416-6	"1-=(4	"4/
4	("6- -	(!-49	" "-9/	-66-9/	"91-!/	1!!="9
-	(96- 1	(9= 9	((-46	691-6	(-(-9/	1"4=()

Oansen#OodricG

"	!=	!-9	1="6	!-9-	L. UMN	L. UMN
(	1-49	1="6	"-99	"-/(	L. UMM	L. UMM
4	"=1!	1/!"	4-46	(-49	L. UMM	L. UMM
-	"-6"	"-(1	-- 1	4-(-	L. UMM	L. UMM

U@

Maturit8	Const	8D1E	fD"E	fD(E	fD4E	fD-E	C' i#sFuare D-E	R sFuared
"	# -4	#!= !	"-(-	"-6/	#1="1	(= 6	#1-64	!-/-
(	#1"- 6	#1-/-	4- (	#4-4/	#"-(-	6="4	#16-96	!-4
4	#1 -(1	#"-("	6-96	#6=	#(- !	/-6	#1!-1	!-1
-	#"-1-64	#"-//	/-9	#9- (	#(-9"	11=""	#-96	!-49

. e, e8 Test

"	/ 4-66	((-14	"9-!6	4-!-6	(-/-69	199-9
(	14/!-/"	-6-1-	49-4	6"-("	6! -1	((/-//
4	"!!9-16	6-""	6 -49	1! (4-1!	"/(" = "	46!-! /
-	"-11-9-	9-((	/4-4	1"9"-!	1! "9-!	- -44

Oansen#OodricG

"	!-99	!= 9	1-64	"-16	4-("	"-6-
(	"-/(	1--	"-9!	(-	9-6	-- 6
4	(-6-	"-16	(-/-	-- "	1(-	/-4-
-	4- 4	"-6(	4-6(	6-94	16-41	1!-66

G1<4. 9:

Maturit8	Const	8D1E	fD"E	fD(E	fD4E	fD-E	C' i#sFuare D-E	R sFuared
"	#(-6	#!=!1	#1-(-	-=(-9	# -/6	4= 1	1/-(!	!-46
(	#6-!4	#!=1	#(-9(	1"-19	#1(- 9	=!1	""-9	!-4-
4	#/-1	#!=64	#-=(/	1 -1	#1 -(-	/-(	"/-1	!-4-
-	#9-9!	#1=1	#6-4	"1-4	#"-1-!	9-//	41-(/	!-4-

. e, e8 Test

"	1"/- "	1!-/(	1! -/	"! -(!	/-9"	-/-6
(	"(1"-	"!-64	191-61	(( -	141- "	1! 6-1 /
4	(1"-9-	(!-1-	"6"-1	-! -//	191-64	144-9(
-	( 9-66	(9=(	(("-69	619"-	((-1	1 -6"

Oansen#OodricG

"	!= 4	!-9	1-(!	1-4(	L. UMN	L. UMN
(	1-46	1- -	(-1 /	(-1	L. UMM	!-(/
4	"-!6	1-/"	4-6!	4-6	L. UMM	!-9/
-	"-9	"-(1	--/9	--/6	L. UMM	1-4"

## D194.&lt;A

Maturit8

	Const	8D1E	fD"E	fD"E	fD4E	fD-E	C' i#sFuare	D-E	R sFuared
"	#"-9!	!-="1	#1=94	#!/-	/-!"1	#4-9/	16-91	!-4!	
(	#4-9"	!-1/	#4=-1	!-6!	1-9"	#11-!"	"6-(6	!-46	
4	#6-6	#!-1(	#6-!	1-!-	""-	#1-=/4	(-14	!-49	
-	#/-1	#!-=4	# =""	1-!/	" -1(	#19-"-	4!-94	!-!	

. e, e8 Test

"	96-19	-=(!	1-=1/	"9-64	6"- 1	//-!4
(	16(-!6	9-4	"/-1/	-4-!"	1! 6-!"1	149-(6
4	""1-"-	1(=9	46-16	/--(	144-! -	"! (-14
-	" 1-(!	1 = (	66-4	119-/6	1 6-6	"49- (

Oansen#OodricG

"	1-"	!-6	!-/9	"-69	4- /	(-19
(	"-!"	1-! !	1-!6	4- -	/-46	--6
4	"-9"	1-"/	1-!"	6-19	11-1	-61
-	(-4	1-46	1-"	4-!"	14-! 4	9-4(

---

## Appendix 8 – 2! (pper Criti\$al 3al%es or %p to Five De)rees o Freedom

Probability of exceeding the critical value				
0.10	0.05	0.025	0.01	0.001

1	2.706	3.841	5.024	6.635	10.828
2	4.605	5.991	7.378	9.210	13.816
3	6.251	7.815	9.348	11.345	16.266
4	7.779	9.488	11.143	13.277	18.467
5	9.236	11.070	12.833	15.086	20.515

, 1 1SS S S #S S ; S ; 0