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Copenhagen
Business School
HANDELSHØJSKOLEN

Contents

Executive Summary

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Figure 1: The Overall Structure of This Paper

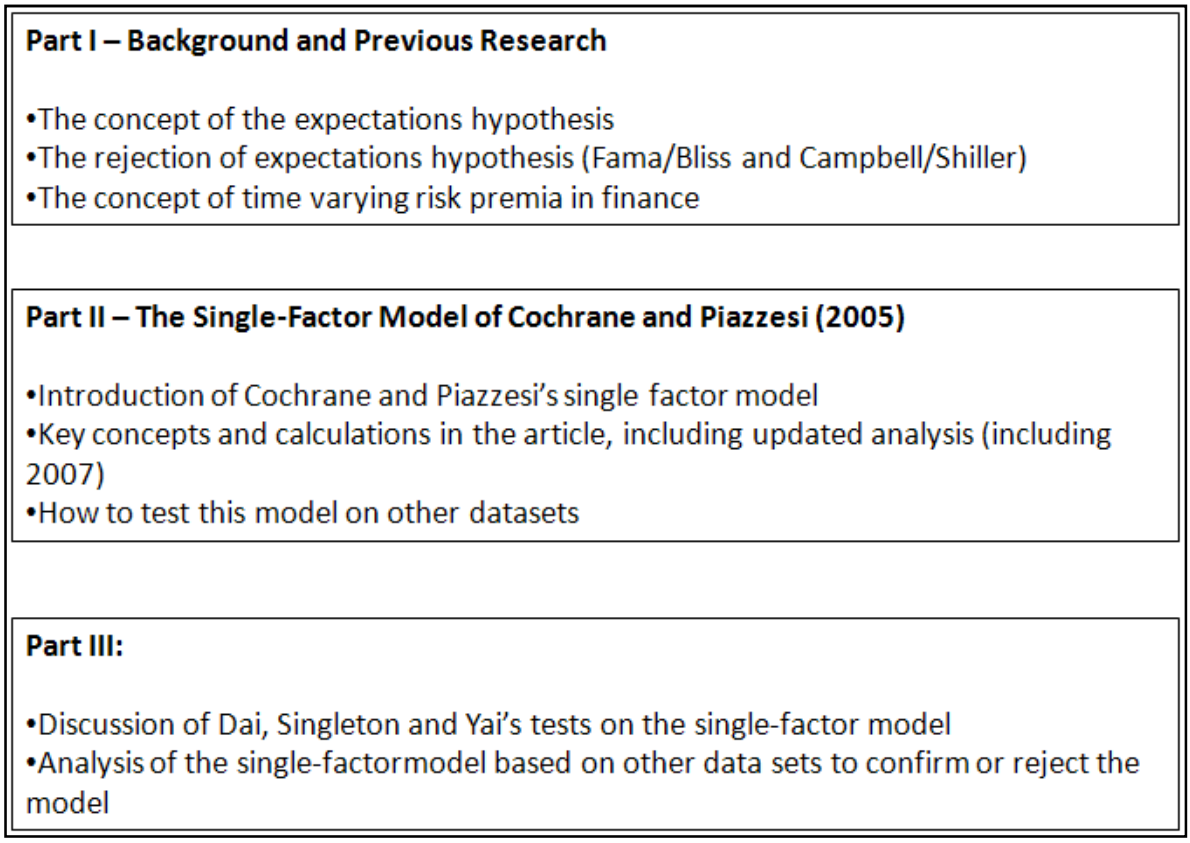

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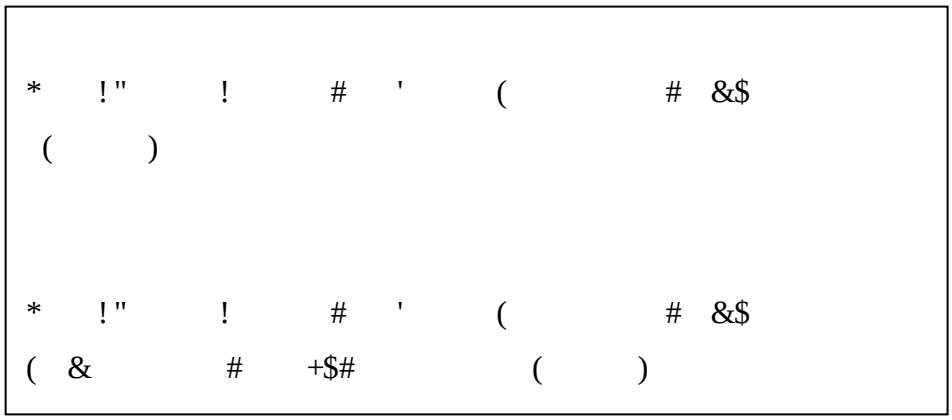
Figure 2 – Summary of the Expectations Hypothesis



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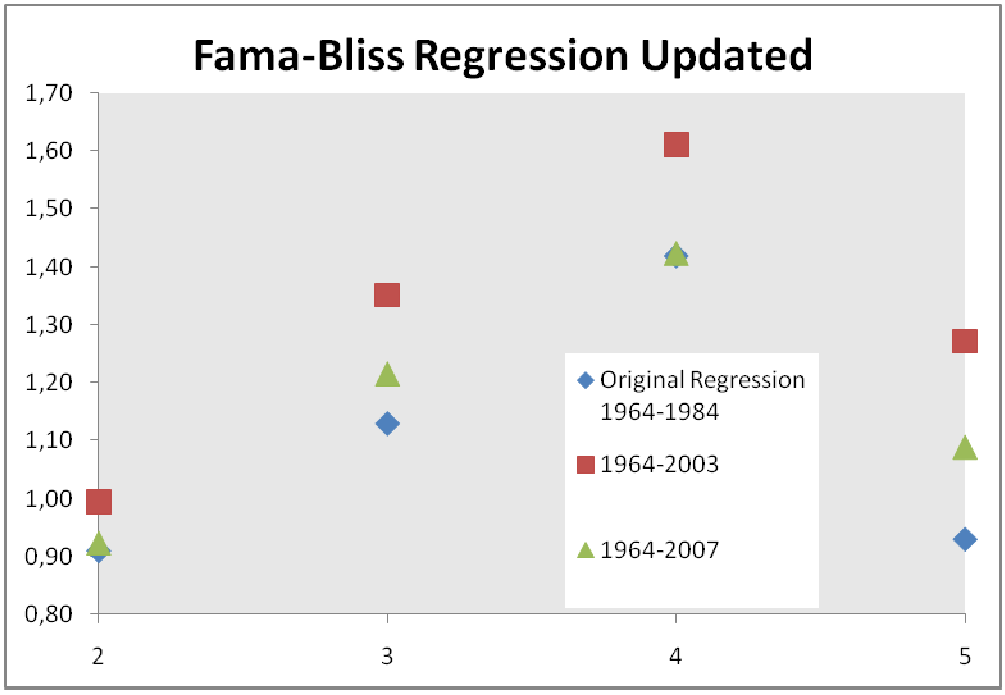

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Conclusion Part I

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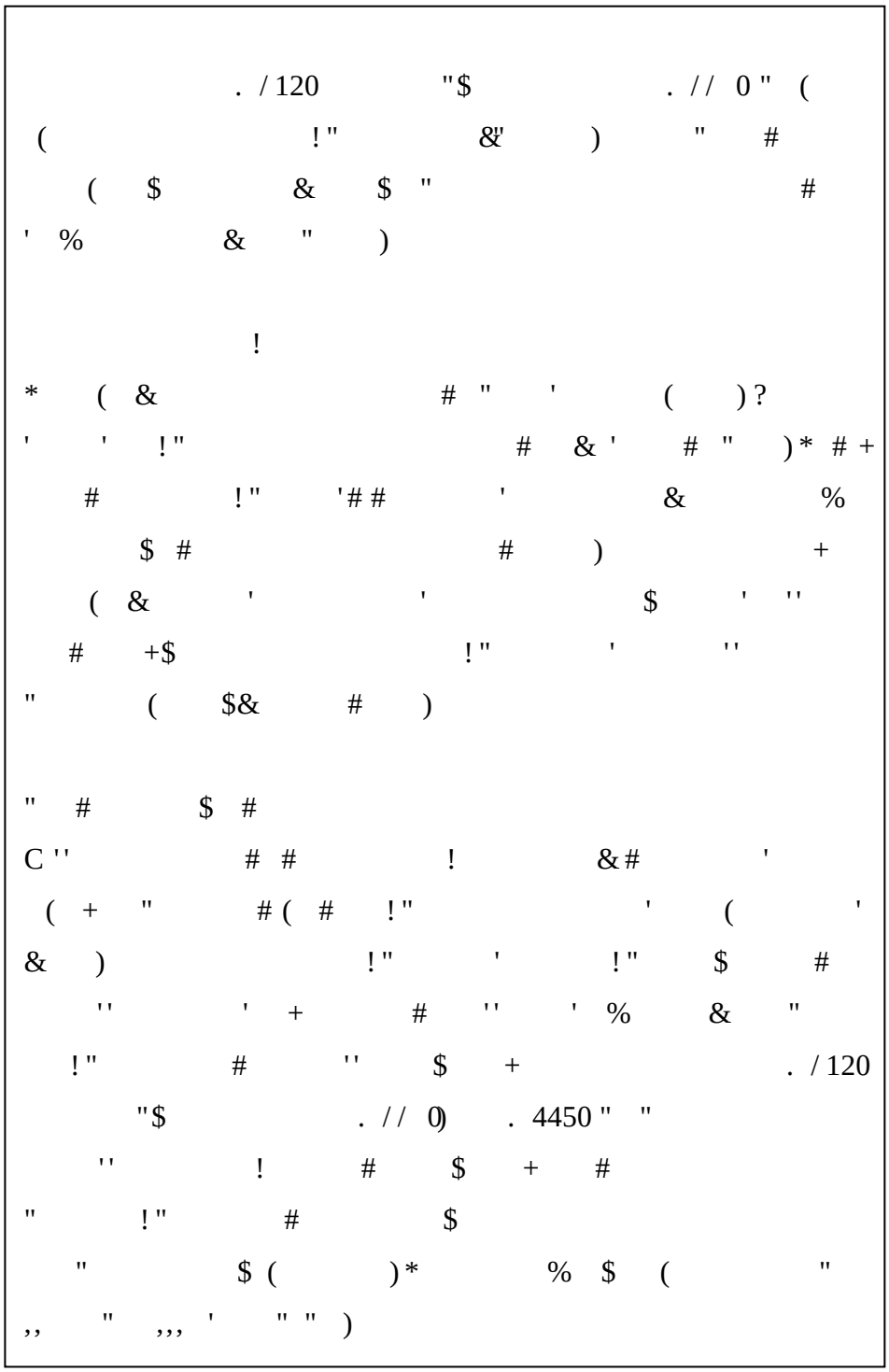

Part II: The Sin!le-'actor Model o$ Cochrane and Pia..esi (/001-

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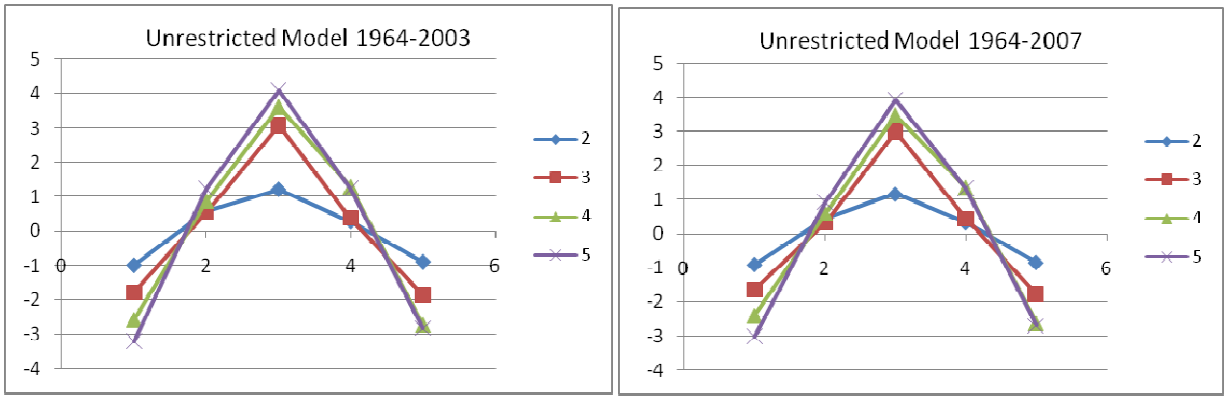

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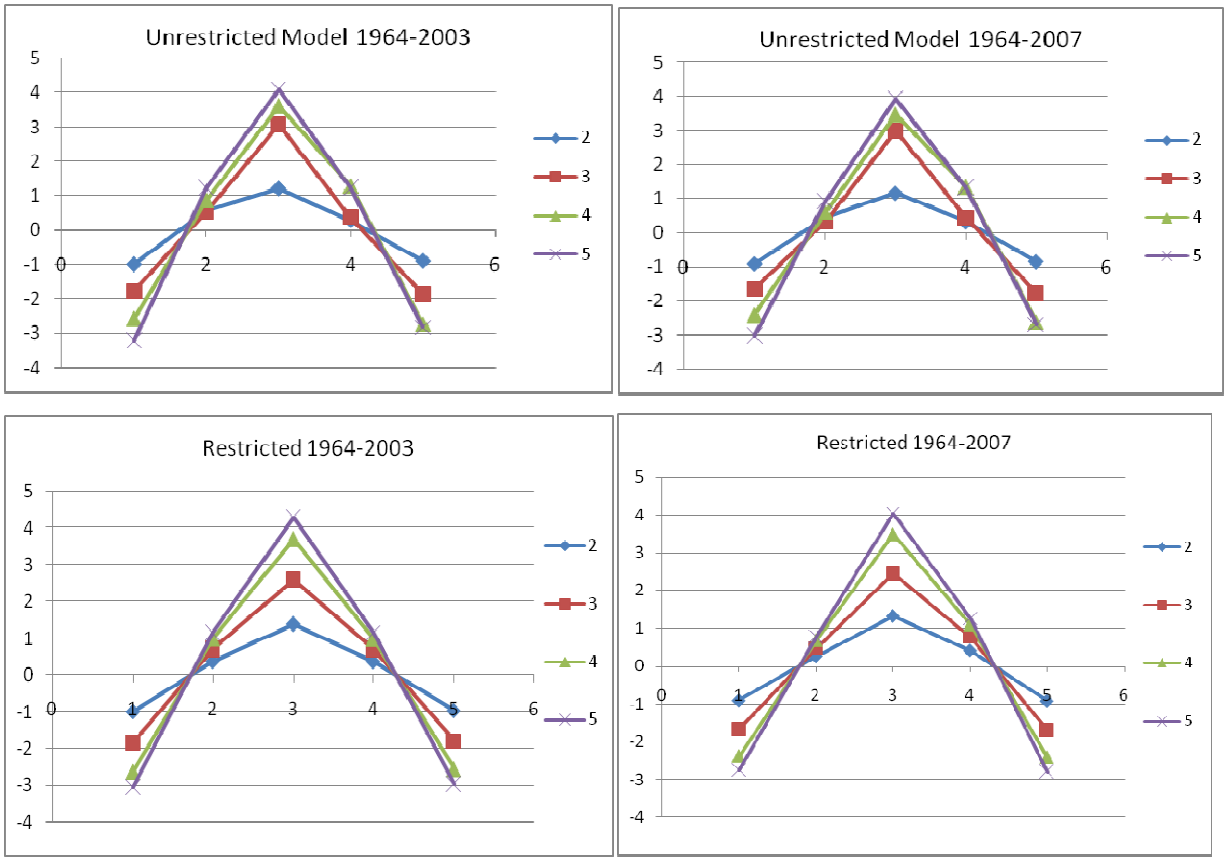

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Ta le , – Single Factor 0o'el Estimates

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Figure 6 –7iel' Factors 2184-!2999%3

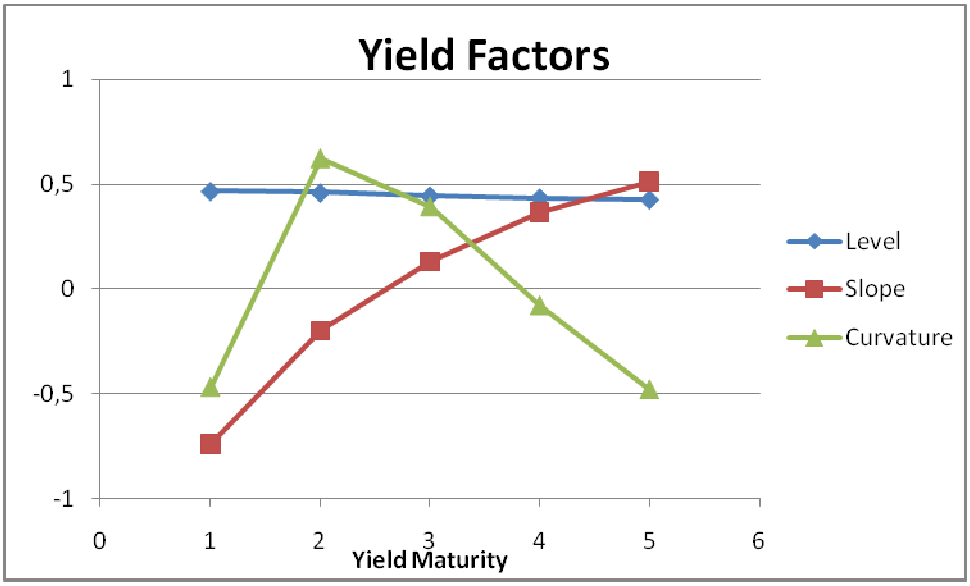

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Figure : – Expecte' #eturn Factor ;<()*97-/006-

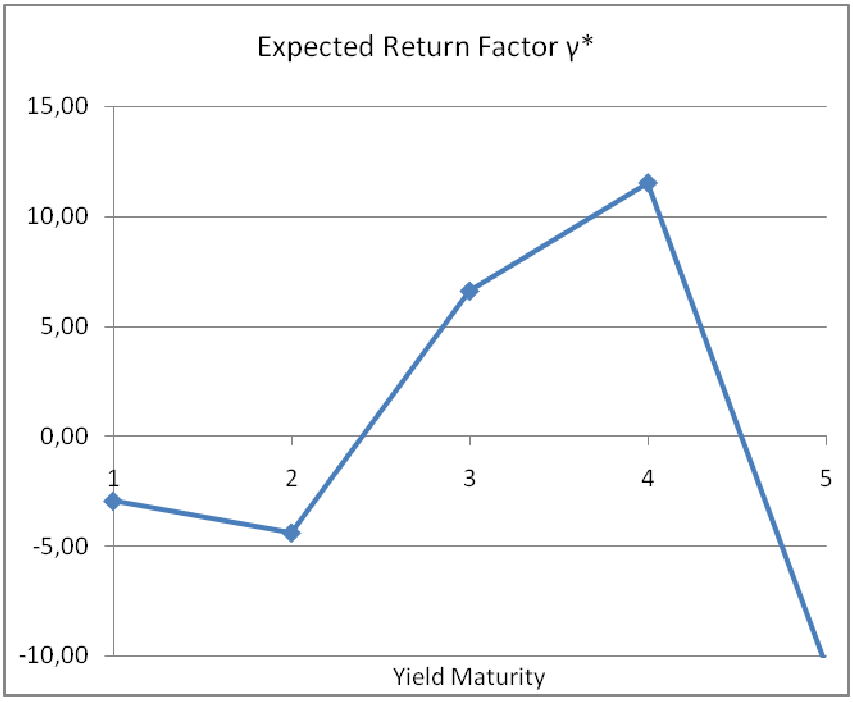

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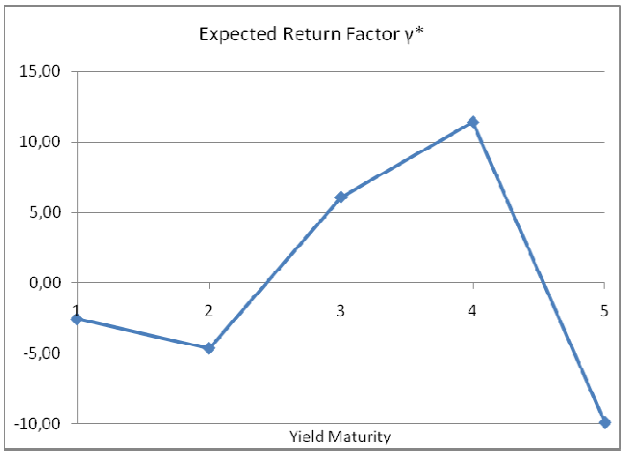
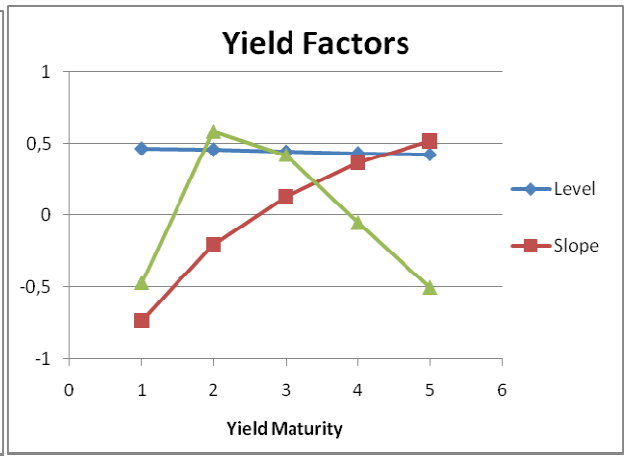
Figure 8 – 7iel' Factors an' Expecte' #eturn Factor &p'ate' 2184-!29963





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Ta le **4** – Forecasting **=**ith **7**iel**'** Factors vs**5** Single**!**Factor **0**o**'**el 21**84-!**299**%3**

Y1**6:7** F**-;.<**04	R-**45/-06**	N**6=62 (64.** C**3**1-**45/-06**	S1**>?:1@167** HH C**3**1-**45/-06**	1 **?60;68.** **;**01.1**;-: A-:/6**
Slope	**<**522	**=**25*****	20**5**1	10**5**0
&evel**5** slope	**<**52**:**	**0**75**<**	2**<5**9	115**0**
&evel**5** slope**5** curve	**<**52**=**	**0**25**)**	1***5<**	**)**52

6" & # /8 442 '')J % (%

J % &7 ' (" " $& # 43)K &

' " /8 44)* ')

Ta le 6 – Forecasting =ith 7iel' Factors vs5 Single!Factor 0o'el 2184-!29963

R193. 3-87 A-01-B:64	R-45/-06	N6=62 (64. C31-45/-06	S1>?:1@167 HH C31-45/-06	1?60;68. ;01.1;-: A-:/6
Slope	<52<	==52	215:	1050
&evel5 slope	<520	215*	1752	1150
&evel5 slope5 curve	<52=	2)51	1759	)52

Simple Spreads

? "" ' # " & +& " ! # " " +
. / 120 "$. // 0+ $ " , '
" ")? ($ (-# $ & '
" ')

7 '' " " + . 4450 (' & " $ %
5 & & &)* (# ' ' . / 120
"$. // 0+ !")J ! + &# & 5 & & " &+
% # $ # ' (" +' & ') '
"" % (+ & +" ('
& " # $& ')J %+$& & + & & +
53 + "" $ ')
* " (# ' J % &7 G 4-4 4/ " +%
" ' 9 9 & /-13 (." (# O4-4/1 0) + " $ %
& 5 & & + " $ % & 5 & & "
')K $ ' & " ' % . 4450)

Ta le : – Simple Sprea's vs5 Single!Factor 0o'el 2184-!2999%3

S1>?:6 S?06-74	R-45/-06	N6=62 (64. C31-45/-06	S1>?:1@167 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+5y(9+	<522	:957	2:5=	1150	75*
y(1+5y(:+5y(9+	<500	)51	:5=	)52	=5<

* " # & ! &% . 4450' % " ('
' +&)7 ' # ' ' " " " ' & $ 4-4 " +

&' ' # " +% : (& ' # ' (& & " ;+
!" + " ' ' ')

? % (+ ' & & ' + ' $
' ' . 4450) " " " ' -# & ! " %
& ' + 5 & & #)? + 5 & &
" " ' ' ' ! #)

? #" & ' " /8 442 (% # +$#
& $ (% ." (# ' 4-4 5 4+ 5/ " (&0)

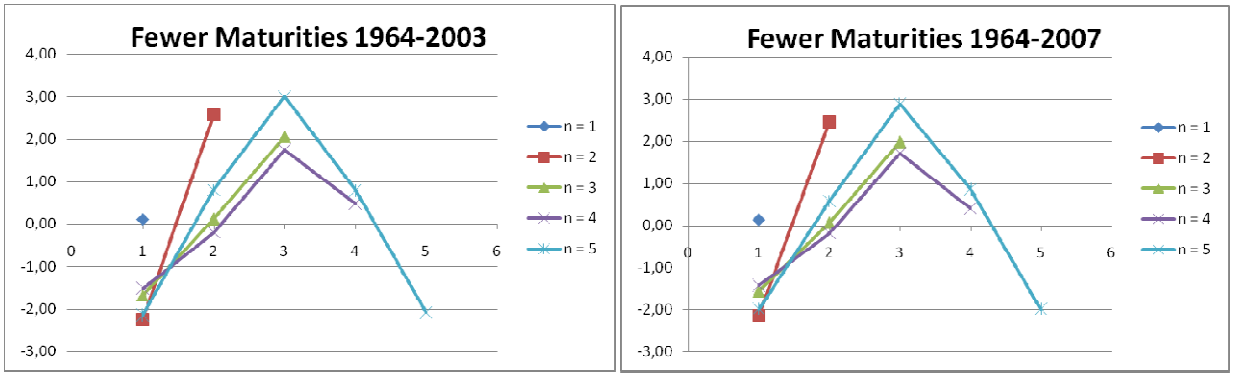
Ta le **8** – Simple Sprea's vs5 Single!Factor **0** o'el 21**84-!**2**99%3**

S1**>?:6** S**?06-74**	R-**45/-06**	N**6=62 (64.** C**31-45/-06**	S1**>?:1@167** HH C**31-45/-06**	1 **?60;68.** **;01.1;-: A-:/6**	5 **?60;68.** **;01.1;-: A-:/6**
y**(9+ -** y**(**1+	**<519**	**)95:**	**0150**	**1050**	**)59**
y**(**1+5 y**(9+**	**<5**22	**:15<**	225**0**	115**0**	75*****
y**(**1+5 y**(:+5** y**(9+**	**<50**2	***50**	**:50**	**)5**2	**=5<**

1 4 "obustness Test **3** ith **"**espect to **:** umber o**$** Maturities Included

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

Figure 19 –#o ustness =ith #espect to 1um er of 0aturities .nclu'e'



Intermission: Model "e;ection and Conse<uences

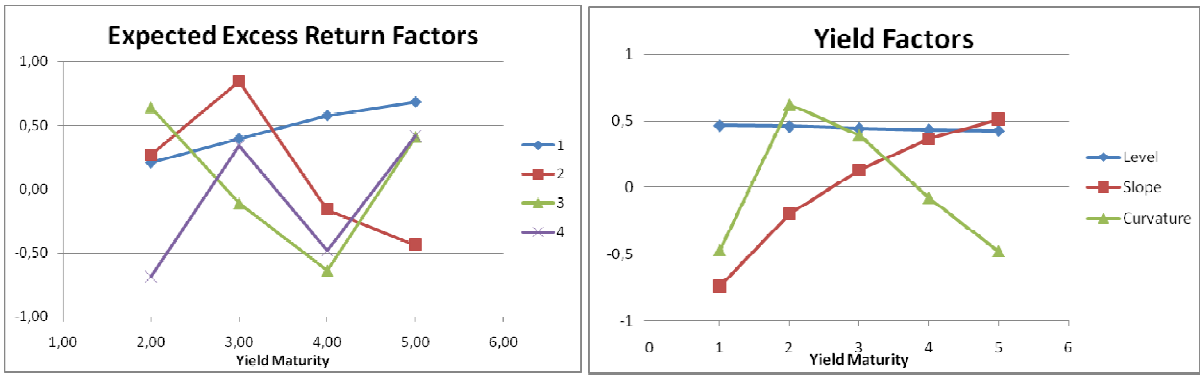
' + (& $# % ' ' '
. 4450) 9 % (+ +% ' ' $ % #
$ " + ' $ " +
) ,)) -# &% ' + ' #$ # '
) ,' + ' # ' ' " &
) * # % # $ $ +$# . 4450 #
(# $ ' ')

* $ L " ' + $ & " ' " ") 9 % (+
' % " " % &') + ! " +
% + ' " ' 9 9 J K(" +
% % + " ( ) J % & 7 $
& ') * % ((
" ' $ %) ? % % $! "+ %
(' $)

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

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

Figure 11 – Principal (omponents of 7iel's an' Excess #eturns ! (ompare'



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

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

9 4 Estimation o$ the Sin!le-'actor Model 3ith Multiple =a!s

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

* ' + # ' # # %
# &) > ' " # $ % ' " $#
-# ')* % # (" ')*
% & " # $ " ' # (( )K &
" $)

* '&+ E $ % # $ (: (# ;+)) + & #
$)

$$$ ( ) *+) *+, -.) *+, . -. ///)0*+, 1 -. !'

?' + & # & E $ <

$$$) (*+) (*+,2-.3) (*+,2.-3 4)0 (*+, 1 -. !'

* + & # $ ' + E +
' +# ((( )? "" !) # " " #
" >! +% P ?)

* # # $ $ %)? $ + 3 '
)* % $ $ ' ' + ! ")

Ta le 1**9** – **0** ultiple **>**ags **#**egression Estimates **21 84 - !2 99%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**

? #" & " +$# $!") $

% % ( )

Ta le 11 – **0** ultiple **>**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! &bility

* ' ' ! # # ' # # % $ ')*

$ ( )

* ' ' <

5 **(6)7 *+, 8 -.**
7#

+ " ' % " % $ '' +' ' #

& ')7 " # ! " # + '), " '

(& ' " #" (%),

" ' % " $ %)

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

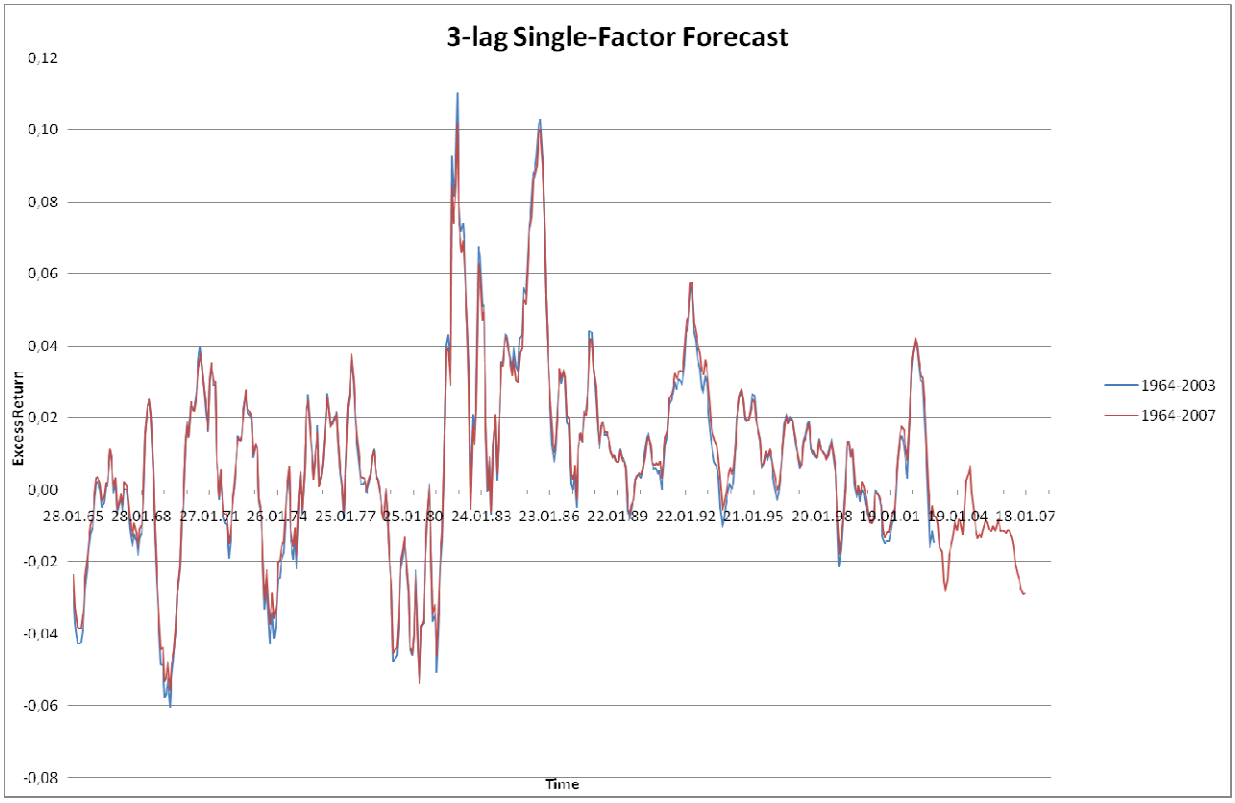


Figure 1% – Forecast (omparing Ex!post #eturns =ith the Perio' 1**84-!**2**99%**

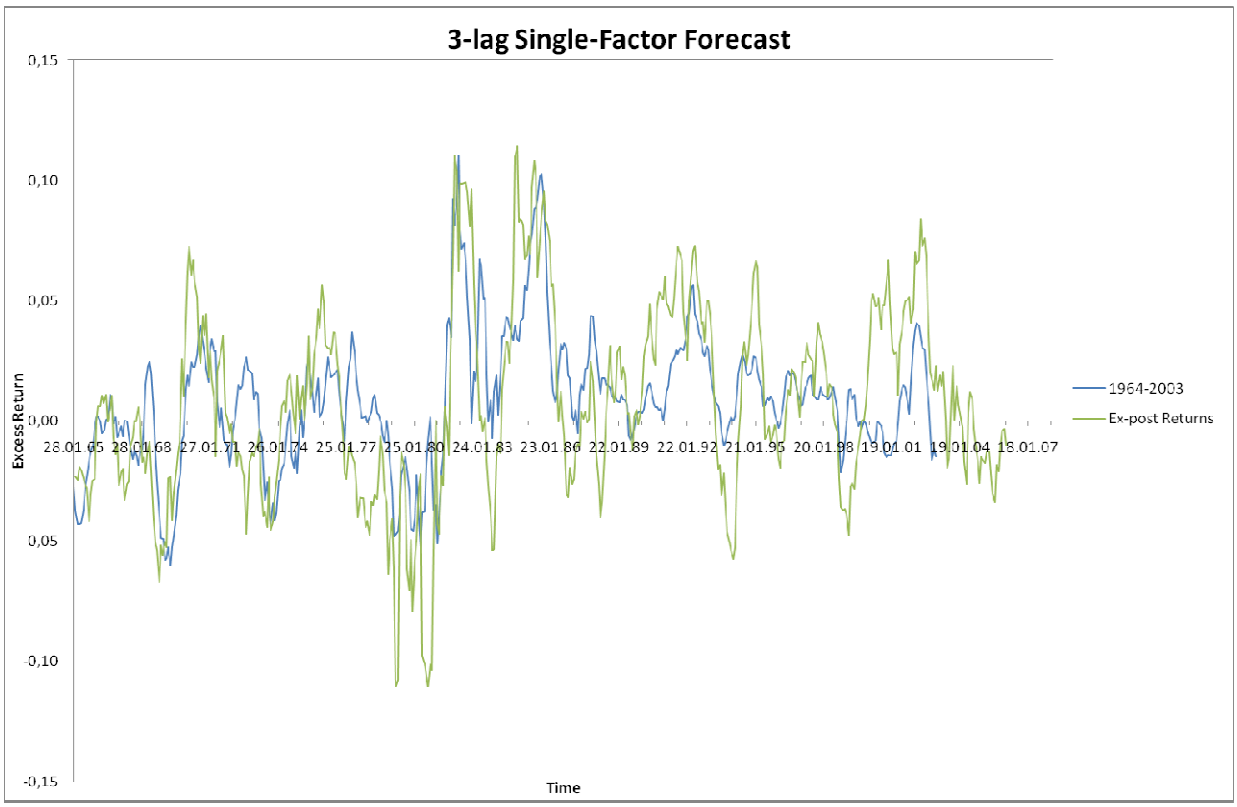


Figure 1- – Forecast (omparing Ex!post #eturns =ith the Perio' 1**84-!2996**

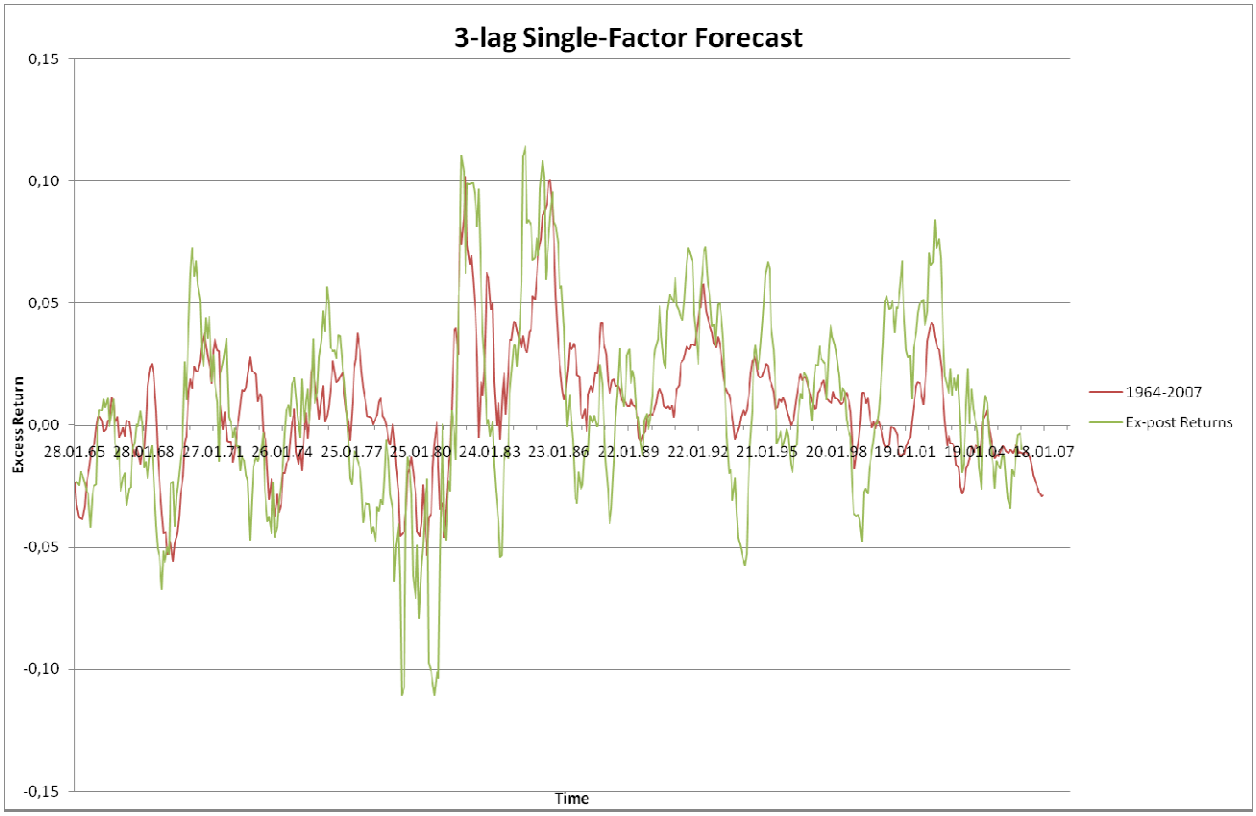
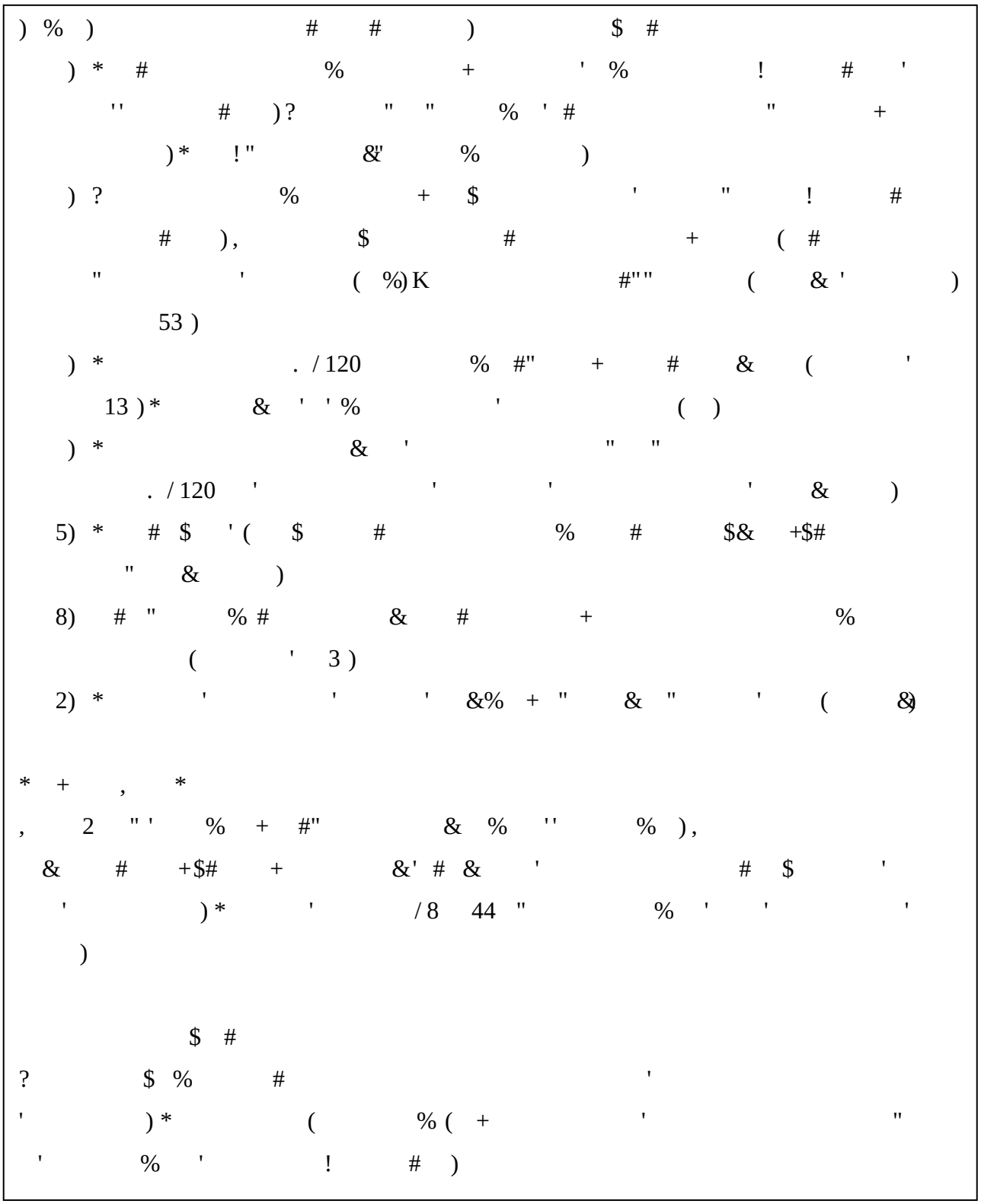


Figure 1, ! Summary Part ..: The Single!Factor 0o'el of (P 2299,3



Conclusion Part II

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

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

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

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

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

Previous "esearch

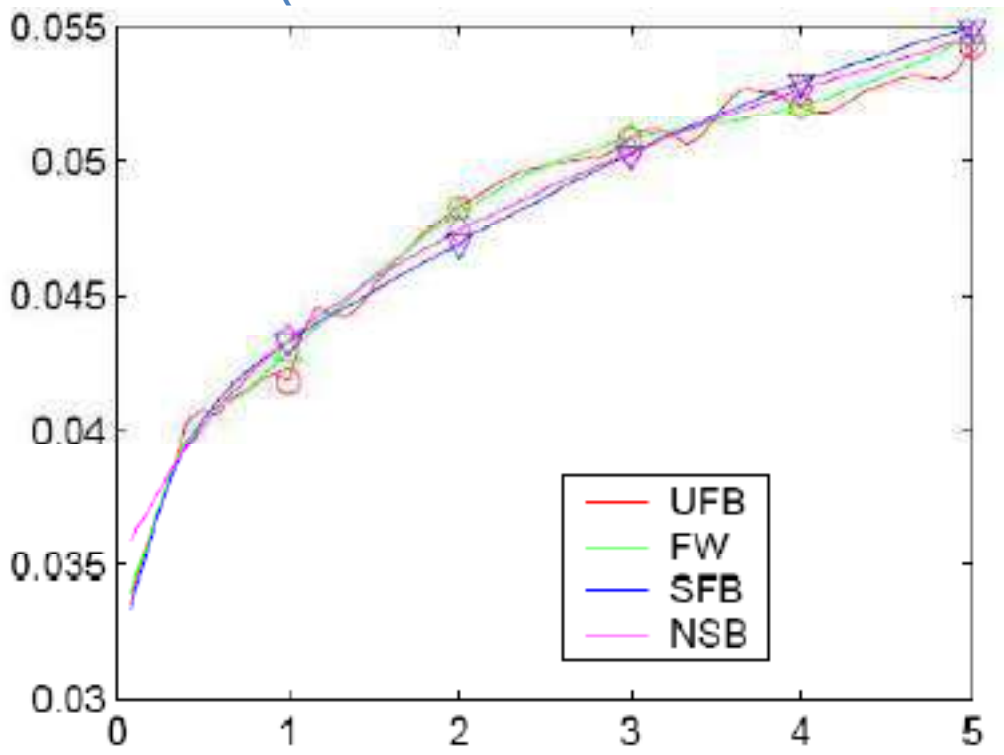
L ("" # ' . 4450+ ' # +
& $ ") ' + " # (#
" . 4450)* % % $&C + Q / . 44 0
(-#) (" -# "#$
" + . 44 0[4])

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

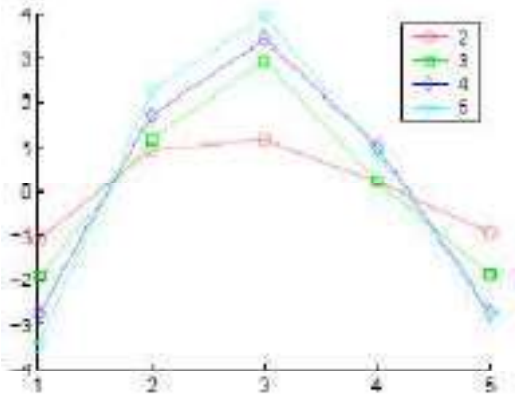


7 ' &' +%

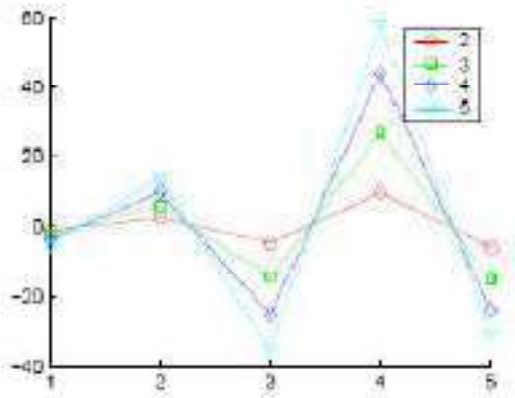
(' 6 +)) (' # . 4450+ " #

")

Figure 16 –?S7 2299-3: Smoothe' vs5 &nsmoothe' ?ata



(a) UFB Data



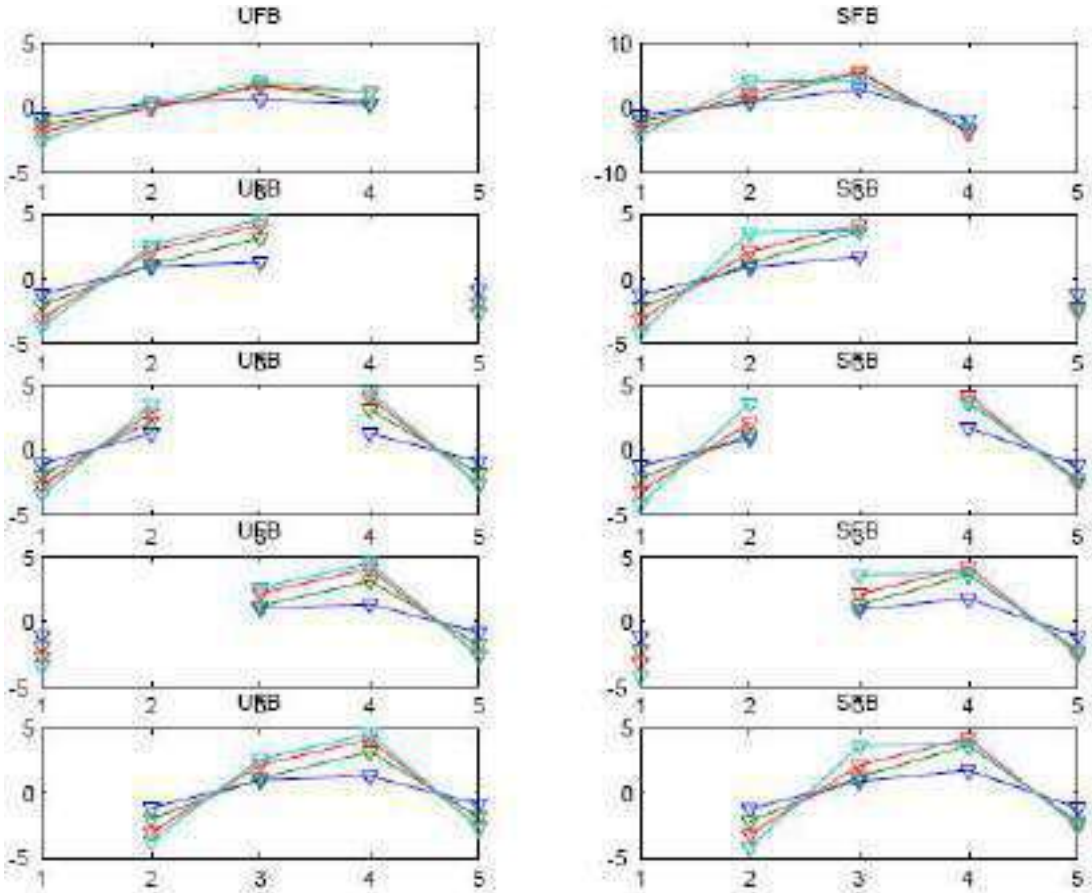
(c) SFB Data

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

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

* # ' "" ' . 44 0 + # "
C Q . 44 0+ " # $ %<

Figure 1: – (P 2299-3: 0ulticollinearity ?estroys the Tent!Shape' Pattern



Ta le 11 – Previous #esearch Testing the Single!Factor 0o'el

%
C Q . 44 0 (') * &"
(#) " " " +
" ' $ + "
"") * & # -# # %
)
. 44 0 " ' (#
&) # # $ ' ($
")

The 'ederal "eserve ?ataset

* 6)) (" (#" ' / 8 ") * &
$ (#" ' # ' (&) * & %
($ # # # LS & . 4480) * &# :
% % " % ' (&% ;) ?
6)) $ % + & # (# $ ' -# &) ,))
-# # # ' ")

* % "" #)> # ' .>K 0 +))
$ # & 1+ +)+ # (&) *
" % $) ? (("# # " #
+% ' % % (" !" "
)

, ($ "" + # # $ (# $ $
!) * # ' + $# " >K # +
) 9 % (+ (# $# + $ "" ($
) "" !)C ' >K # #)

, + ' # % % +' $),
' . 4450 $ + (')

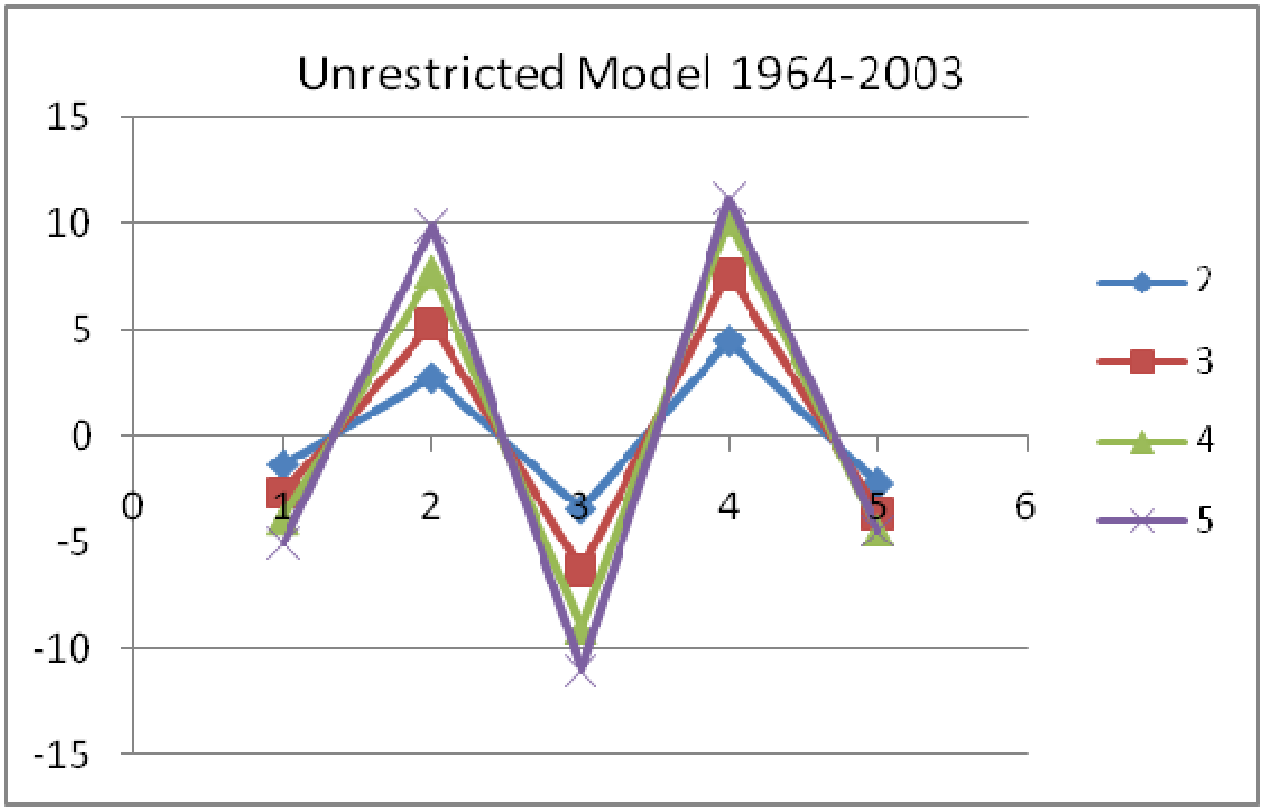
"" !) ' '# " ' + "" !)C ' "
' # # ' ")

) 4 Estimation o$ the 5nrestricted Model

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

"# # " $ " 8 # " ,,

Figure 18 – The &nrestricte' 0o'el



+ " $) % (+ ' "

(' 83 +% & (

' 83) * !" &' & #

% ( )7 $ C " (# % 5+)

' "" ! 5) ' '# # #)

Ta le 12 !+2an' #2 for the &nrestricte' 0o'el

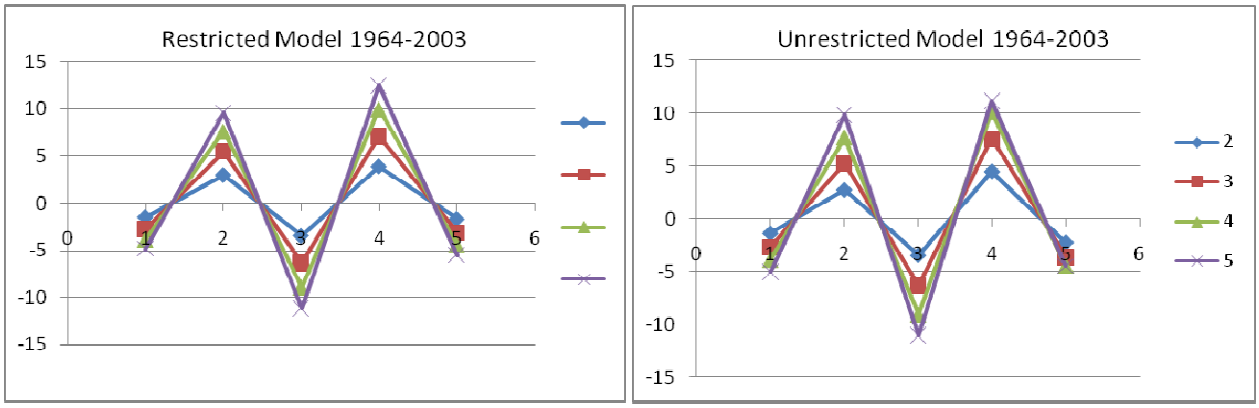
"aturity	F6760-: R6460A6 3hi-sHuare (9+	.2	CRSP 3hi-sHuare (9+	.2
2	2=5*:	<521	1215*2	<502
0	005*<	<520	1105*<	<500
:	0)57<	<529	119572	<50=
9	:05*=	<52=	**51=	<500

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

? % # + ")* " ' # '

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

Figure 29 – #estricte' vs$ &nrestricte' 0o'el



* # # -# +L S & . 4480)* " %

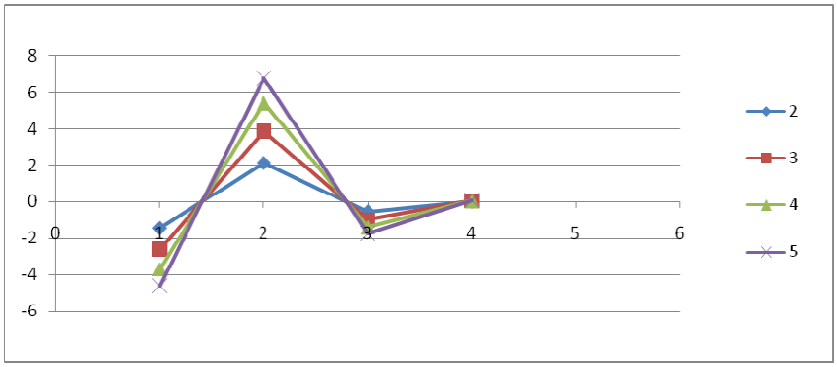
" &" # $&C Q . 44 0+ % $ ( )* -# %

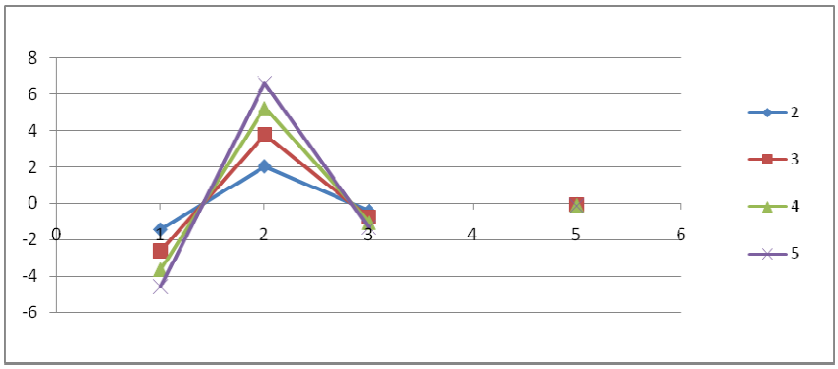
(& ' . 44 0+% % # $& ($ #

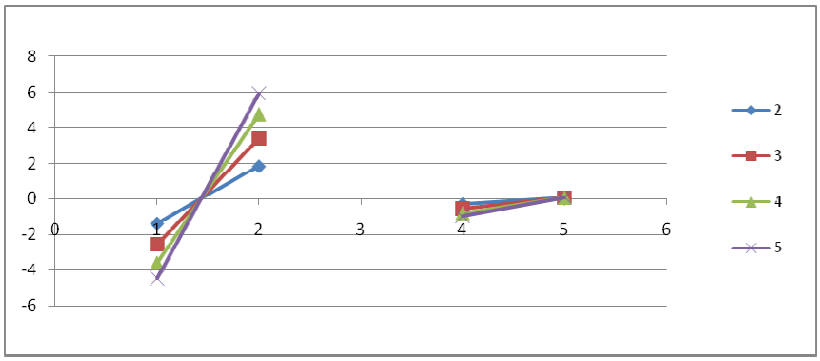
&+ $ " +)? ' # $ %

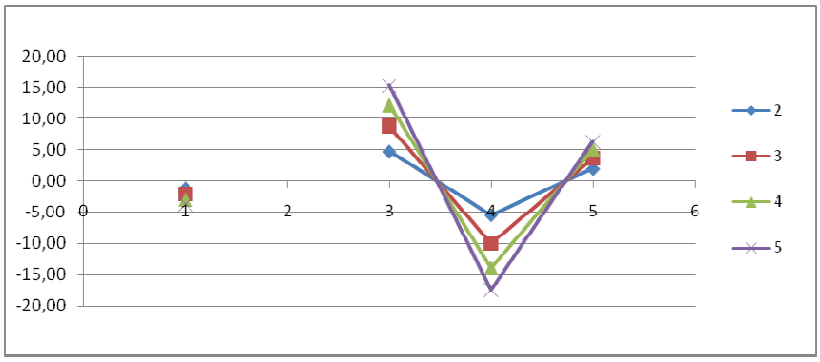
% +)

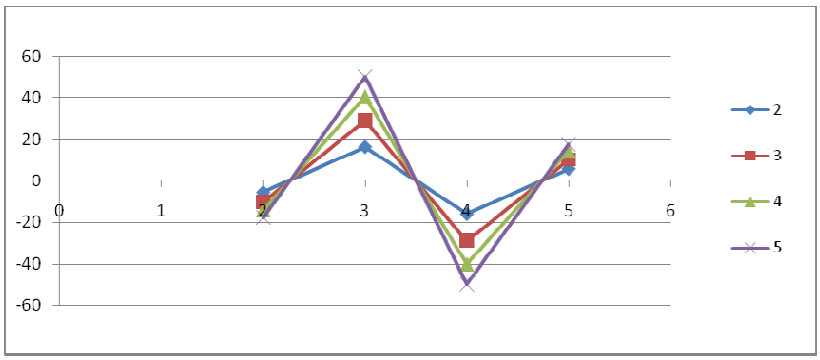
Figure 21 – .s 0ulticollinearity the #eason for the 0issing Tent!Shape@




8
6
4
2
0
-2
-4
-6
0
1
2
3
4
5
6
2
3
4
5


8
6
4
2
0
-2
-4
-6
0
1
2
3
4
5
6
2
3
4
5


20,00
15,00
10,00
5,00
0,00
-5,00
-10,00
-15,00
-20,00
0
1
2
3
4
5
6
2
3
4
5


60
40
20
0
-20
-40
-60
0
1
2
3
4
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6
2
3
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5

@ ' ' $ $ %+

(") ' + #

. 4450+ % # &+$ ' "" ' 5 &

&)

+ " + G (# % ' " (&1 + 8+ +
' 45-5 1+ +' + 1+ ' &' (" +' -8 -2)
* ' ("" &+$# & ' "
(! " ' (" +% " (# ' -83)

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

Ta le 1% – Single Factor **0**o'el Estimates **.**

		Stan**2**ar**2** Errors			
	Estimates	12&ags	#e**A**ey-**C**est 1***&ags	Simplifie**2** 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 % % + $ % ( ) +
(# % '' $ % " '
+% (# M-2N "" ! 5))

Ta le 1- – Single Factor **0**o'el Estimates **..**

n	b$_n$	**.**^{2}	**1**nrestricte**2** **.**^{2}
2	**<5:=**	**<52<**	**<521**
0	**<5*9**	**<520**	**<520**
:	151)	**<529**	**<529**
9	15:)	**<52=**	**<52=**

6.4.5 Updating and Comparing the Fama and French Results

J %+ # . / 120 % "

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

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

(# % ' ' 8-8)

Table 1, – Fama and French 2018:63 Regressions

Maturity n	Original Regressions 1)=::<1-1)*::12			3P Time Period 1)=::<1-2<<0:12			Fe2-$ataset 3P Time Period 1)=::<1-2<<0:12		
	E	. [2]	62	E	.2	62	E	.	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 + & (&

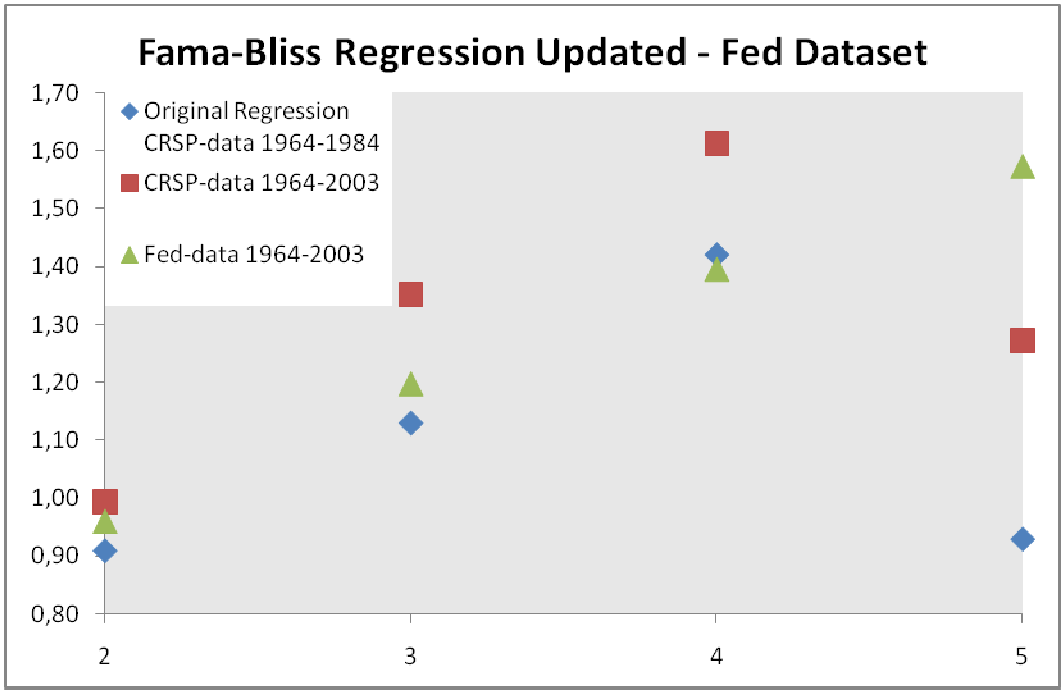
' / 8 / 1 # ')

% (/ 8 44 " % & + %

') # . / 120 #" % +

)

Figure 22 – Fama!"liss #egression &p'ate' an' (ompare')raphically

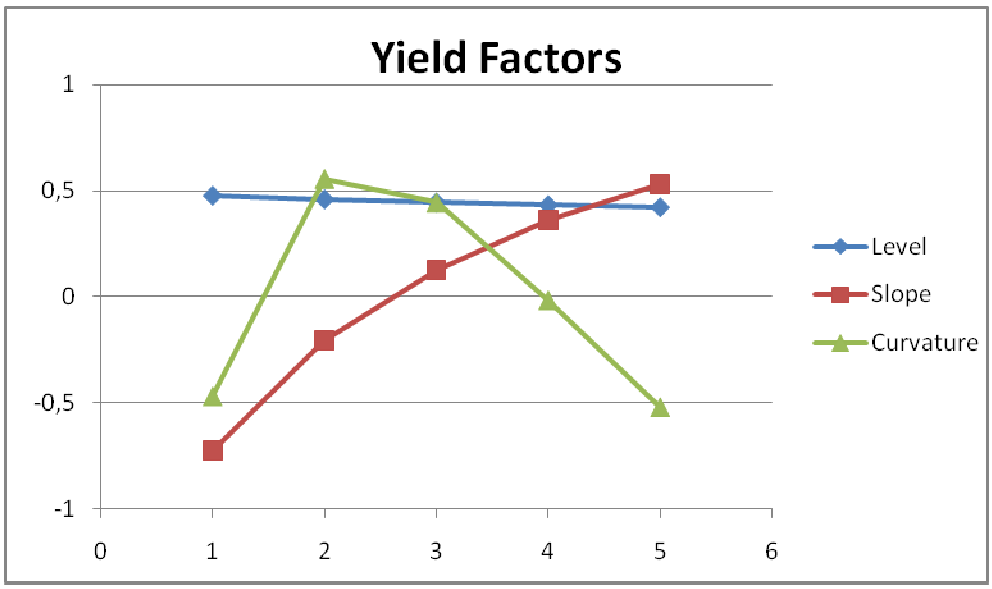


7 4 Comparison 3ith Models o$ the 8ield Curve 'actors

* & ' ')* !" +

' " " " % $)

Figure 2% – 7iel' Factors in the Fe'eral #eserve ?ataset



K + !" # ' (& & ')*
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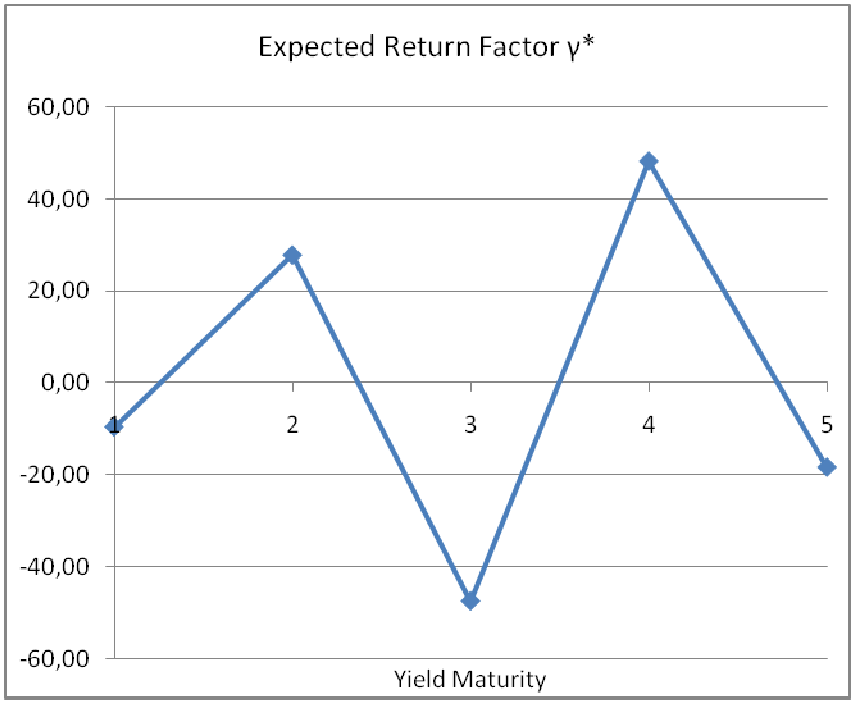
Figure 2- – Expecte' #eturn Factor ;<



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' ! # + ' & ')* # $
' + ! ' $ # ! #
+ " ')

Ta le 14 – Forecasting =ith 7iel' Factors vs5 Single!Factor 0o'el in the Fe'!?ataset

Y16:7 F-;.<04	R-45/-06	N6=62 (64. C31-45/-06	S1>?:1@167 HH C31-45/-06	1 ?60;68. ;01.1;-:A-:/6
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&evel5 slope	<521	=5=	059	1150
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Ta le 16 – Simple Sprea's vs$ Single!Factor 0o'el

		N6=62 (64.		S1>?:1@167 HH	
S1>?:6 S?06-74	R-45/-06	C31-45/-06	?-A-:/6	C31-45/-06	?-A-:/6
y(9+ - y(1+	<51:	1<5:	<5<09	*5)	<5<=:
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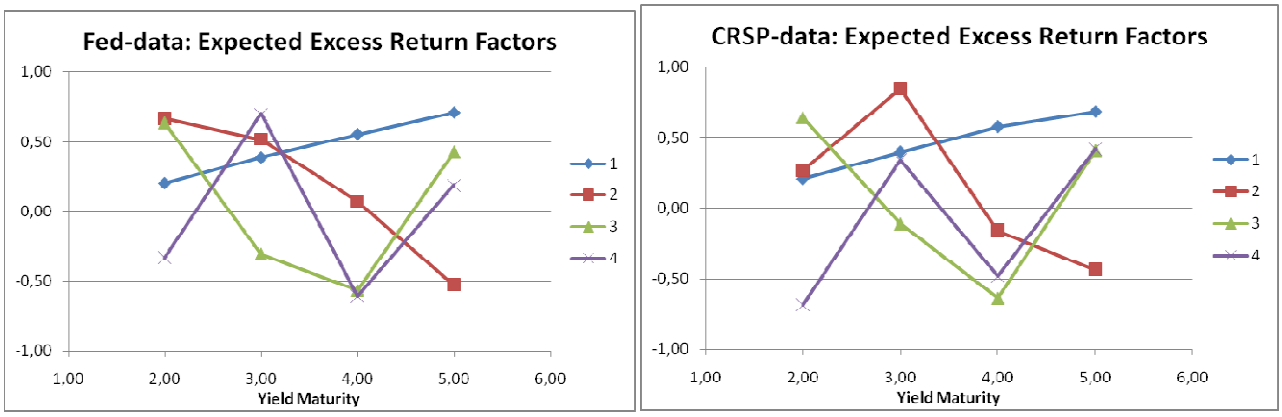
(& '' ' % ' #)

Figure 2, – Expecte' Excess #eturn Factors



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

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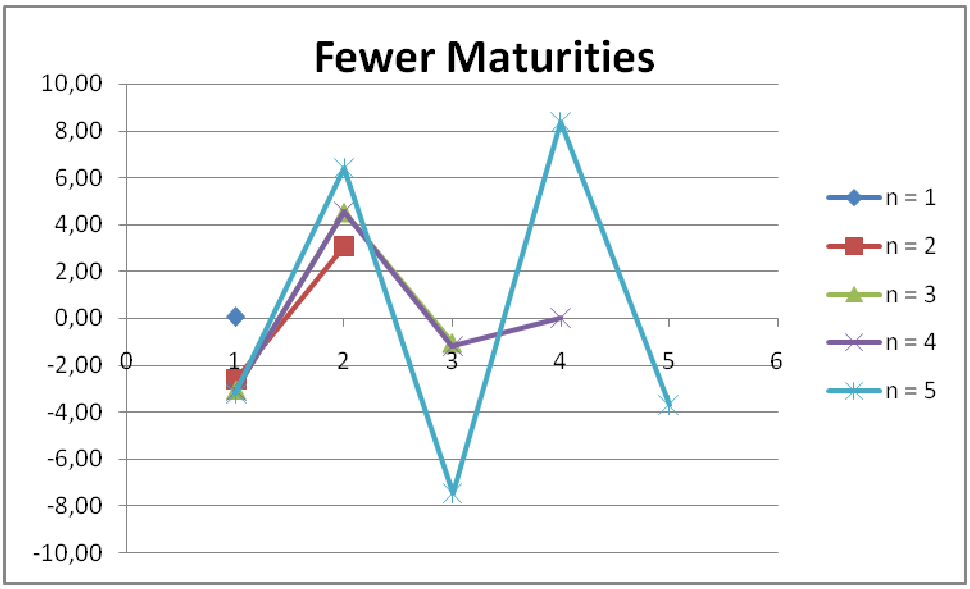
Figure 24 – #e'ucing 1um er of $aria les in 0o'el



9 4 Estimation o$ the Sin!le-'actor Model 3ith Multiple =a!s

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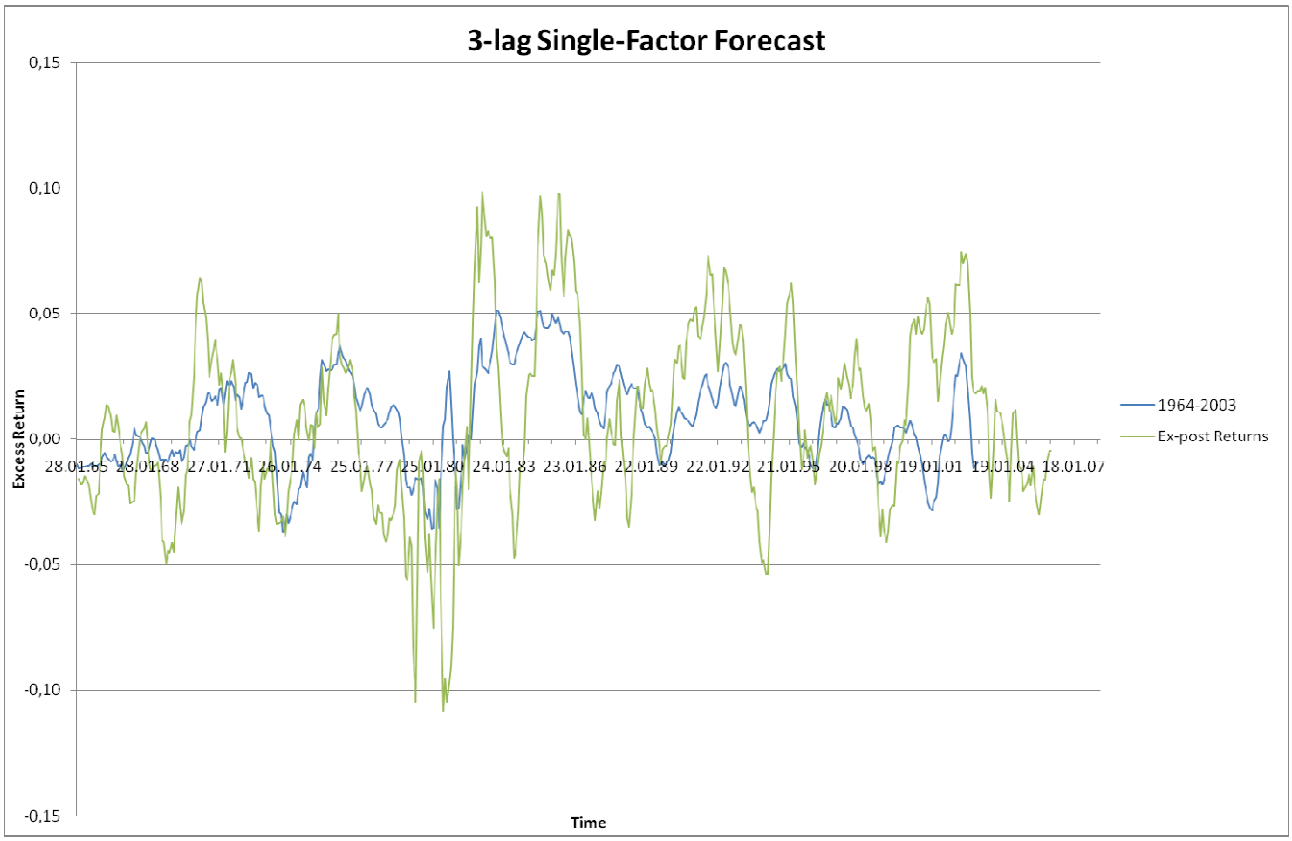
, 4 & Test o$ the Models 'orecastin! &bility

Figure 26 – Forecast (ompare' to Ex!Post #eturns – Fe' ?ata



Conclusion on the 'ederal "eserve ?ataset Tests

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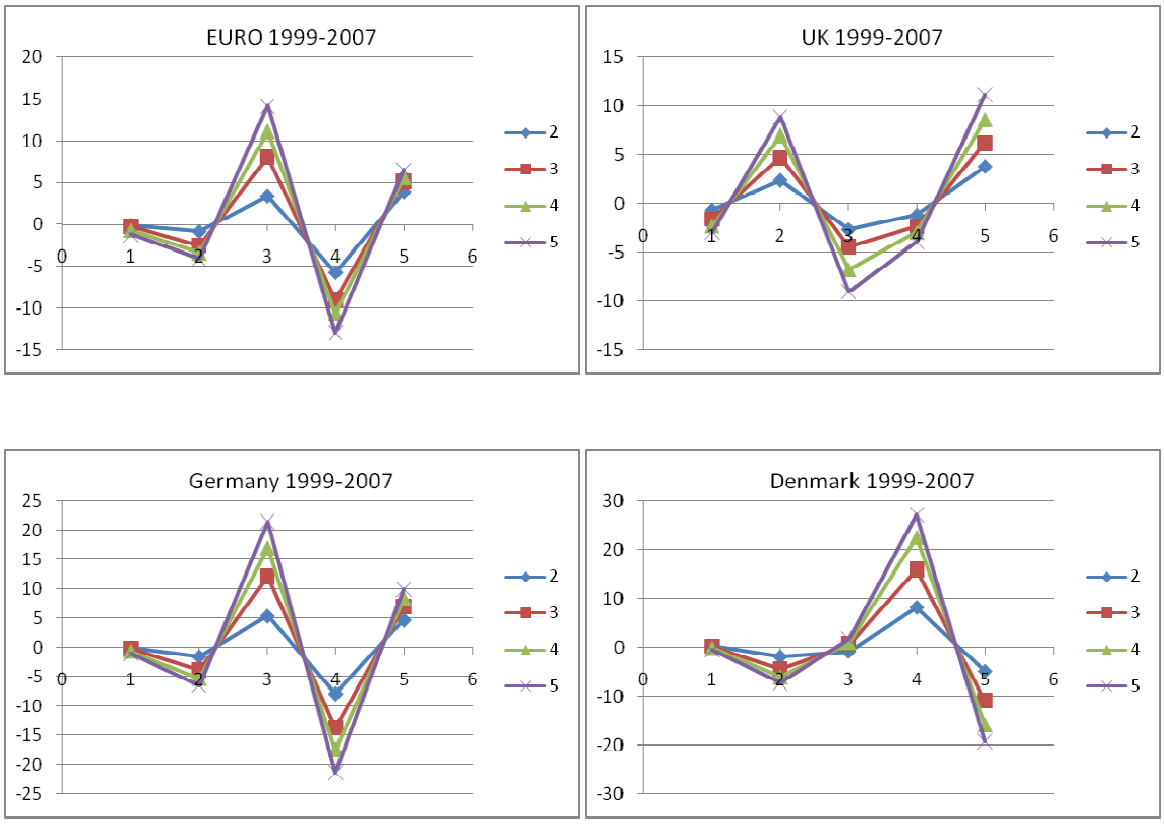
Figure 2: – The &nrestricte' 0o'el/s Patterns of the ?atastream ?ata: Euro* &B*)ermany an' ?enmar/



Conclusion on ?atastream ?atasets

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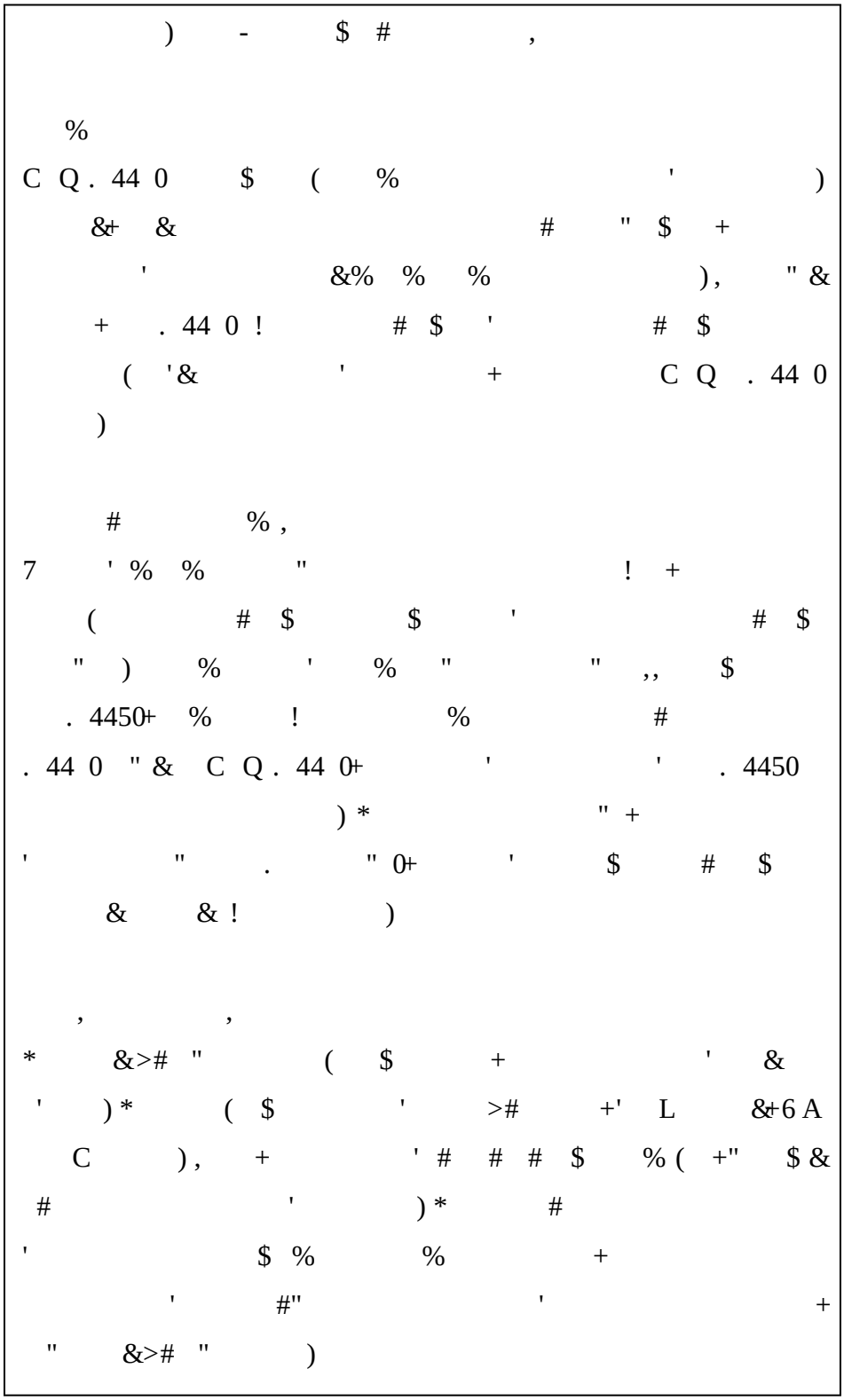
? $ # + ' + % $ #"
' " + " & ># ")

Conclusion Part III

Figure 28 ! Summary Part ...



Conclusion

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U> K Q,>@C; +' ! " 6 A U> K 6 P > Q U> K Q,>@C)

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APPENDIX

Contents

Appendix 1 – Data

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A. CRSP

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+ 5

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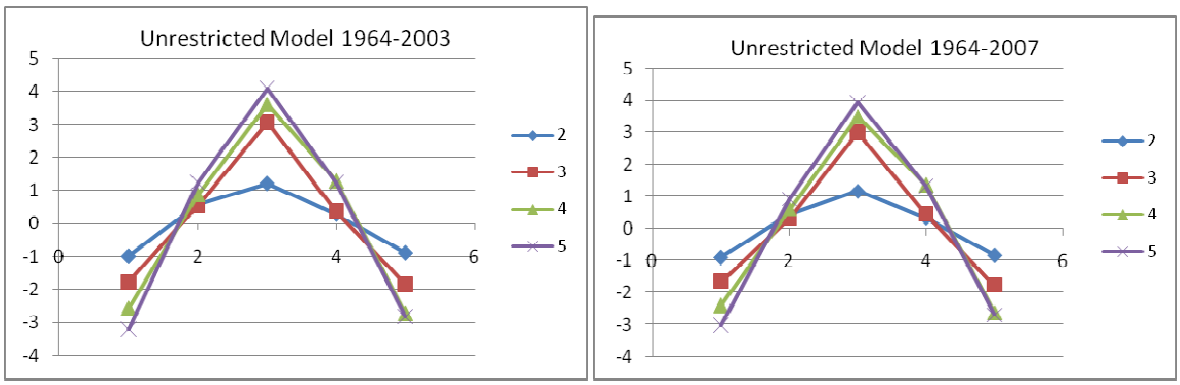
Figure A.1 – CRSP Data Prior to 1964 – Performance on Unrestricted and Restricted Model



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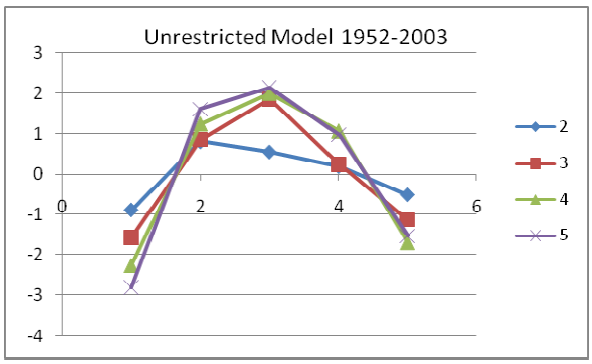
Unrestricted Model 1952-2003
3
2
1
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-1
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6
2
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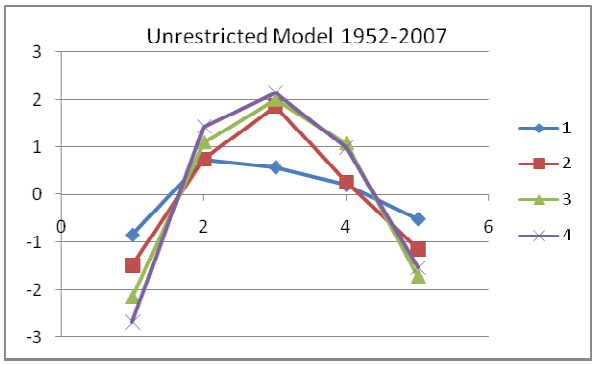
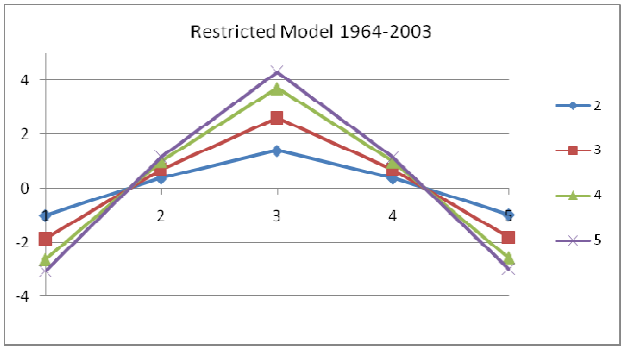
5


Unrestricted Model 1952-2007
3
2
1
0
-1
-2
-3
0
2
4
6
1
2
3
4


Restricted Model 1964-2003
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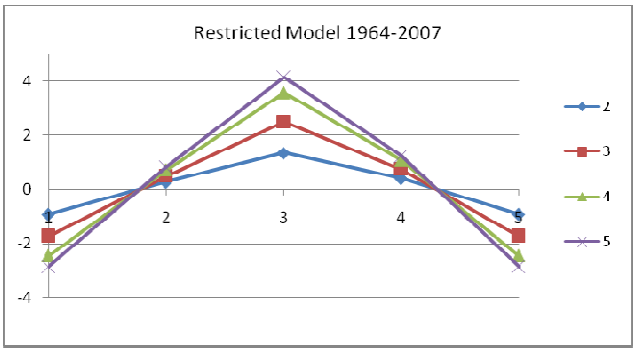
Restricted Model 1964-2007
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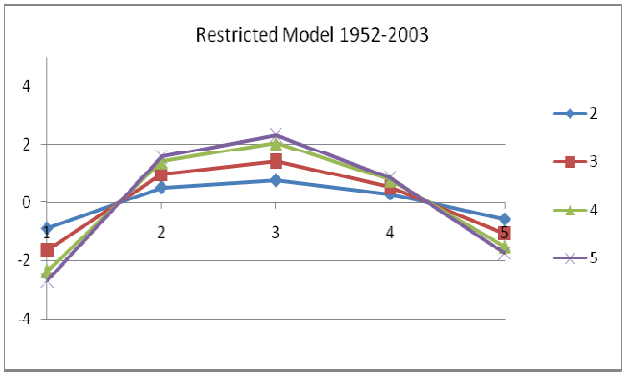
Restricted Model 1952-2003
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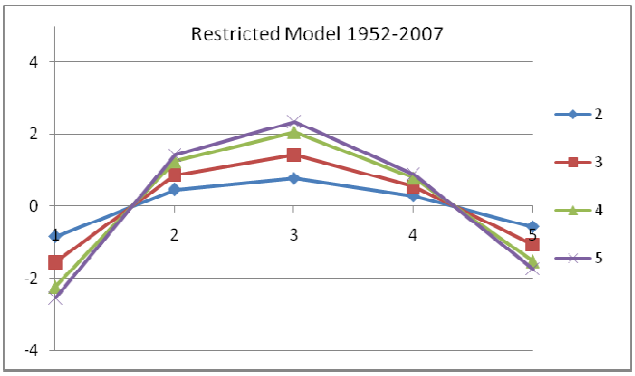
Restricted Model 1952-2007
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Figure A. ! "ero Cou#on $ields on t%e CRSP Dataset

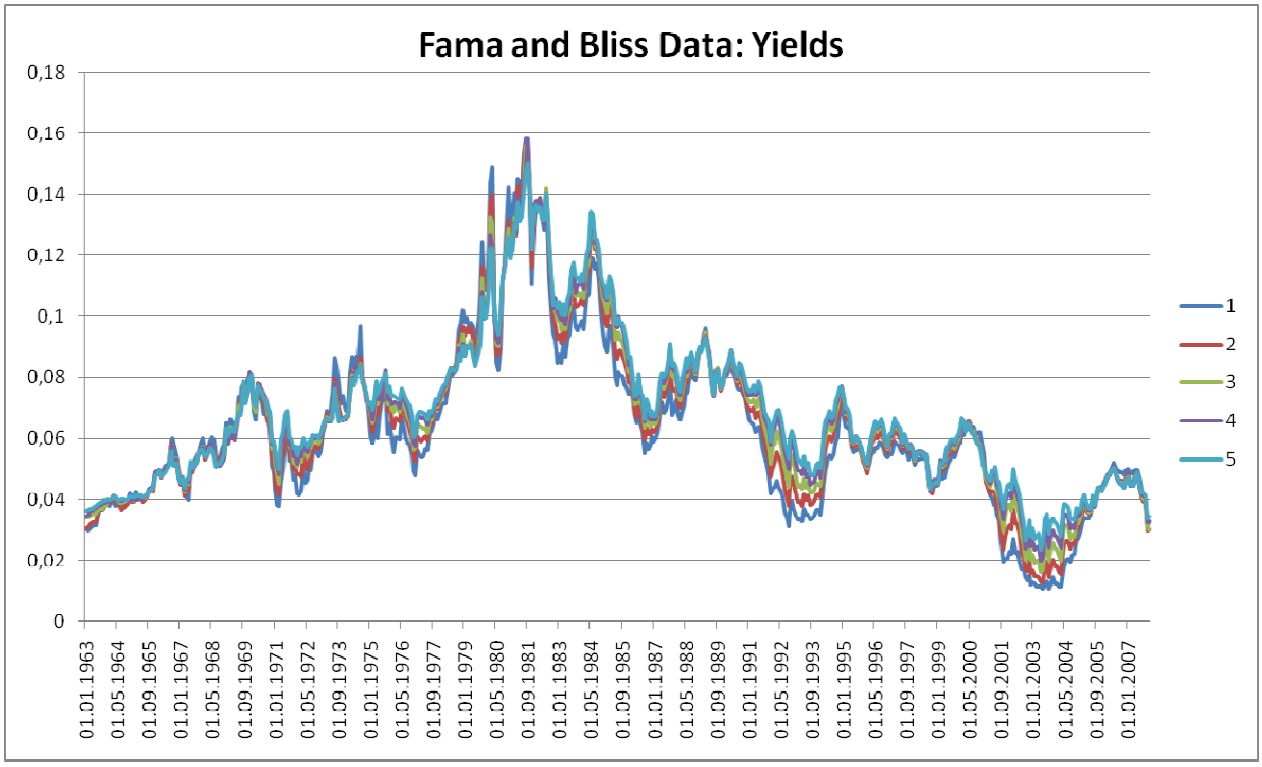

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Figure A.& ! "ero Cou#on $ields on t%e Federal Reser'e Dataset

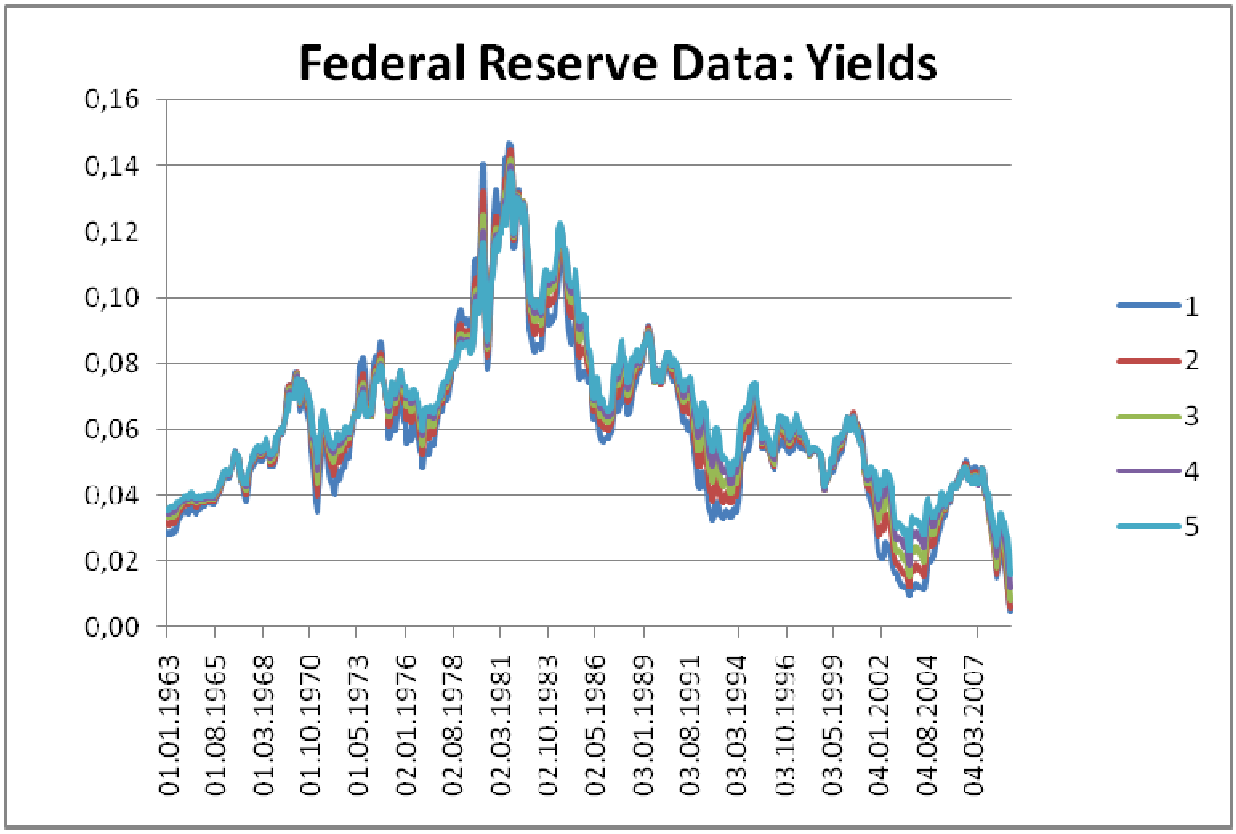

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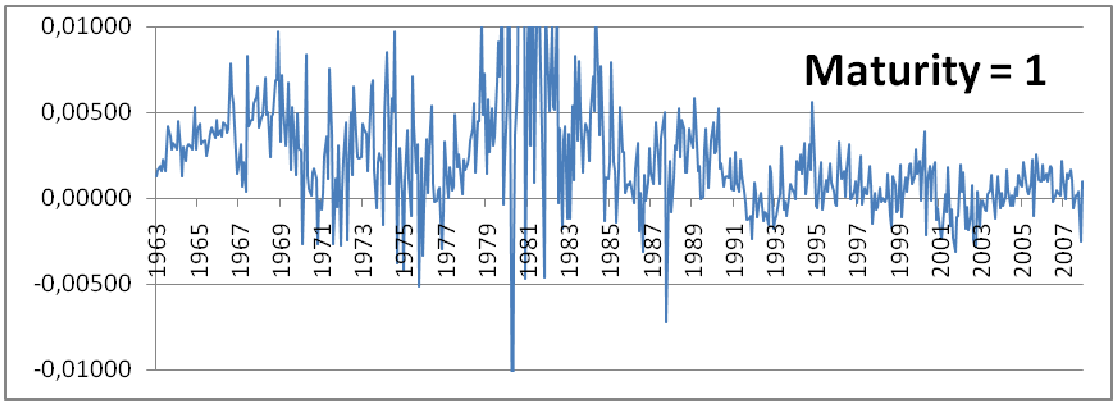
Figure A.4 – (%e Difference in $ields)et*een t%e Fed and t%e CRSP Dataset



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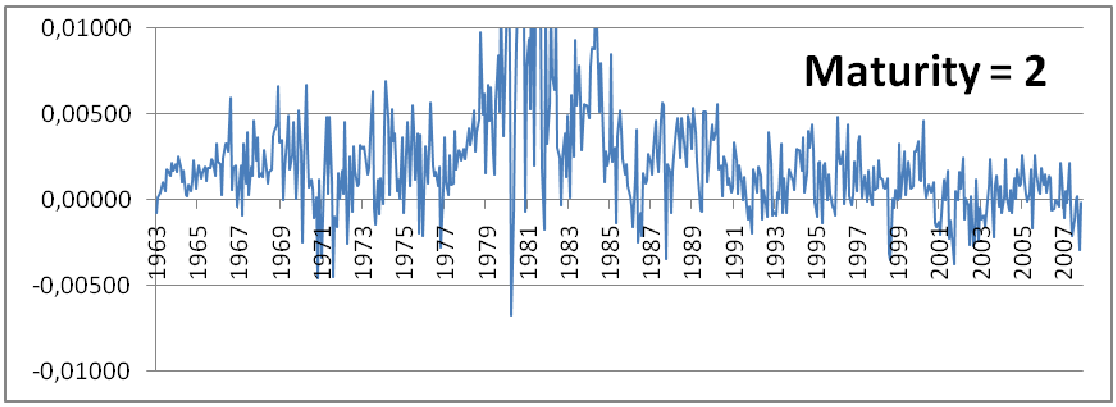
Maturity = 2
0,01000
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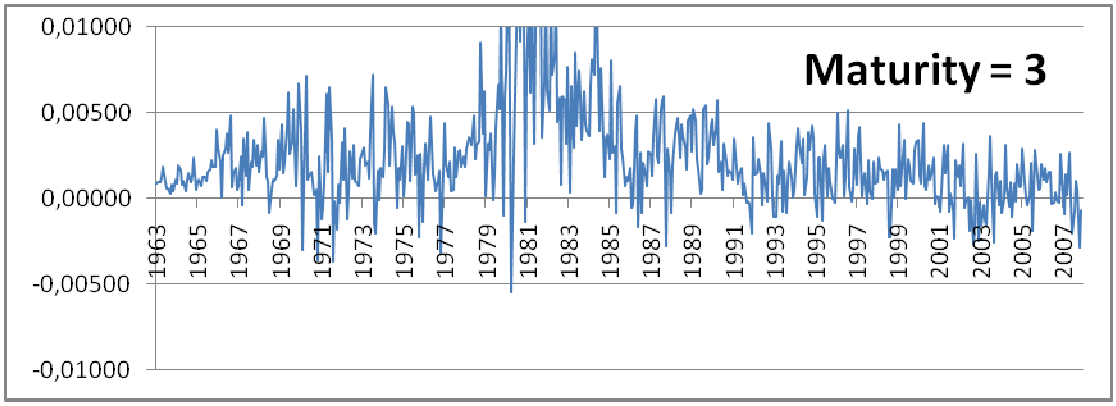
Maturity = 3
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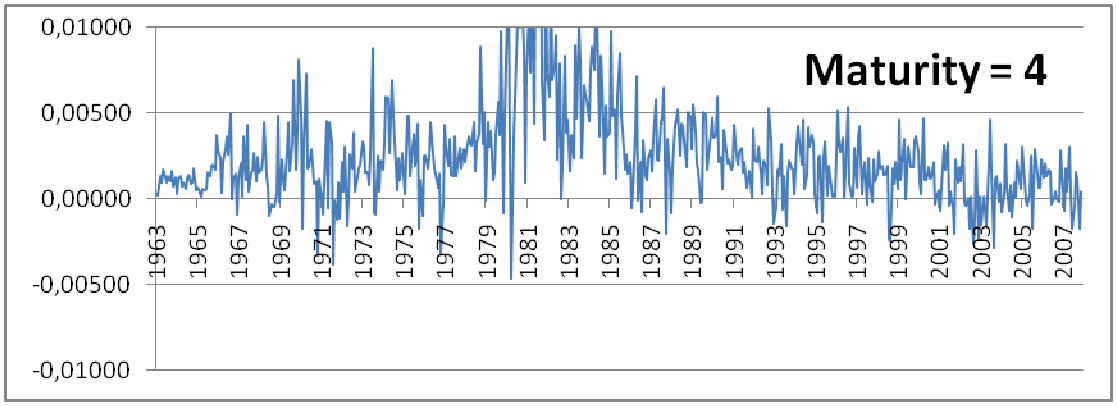
1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007


Maturity = 4
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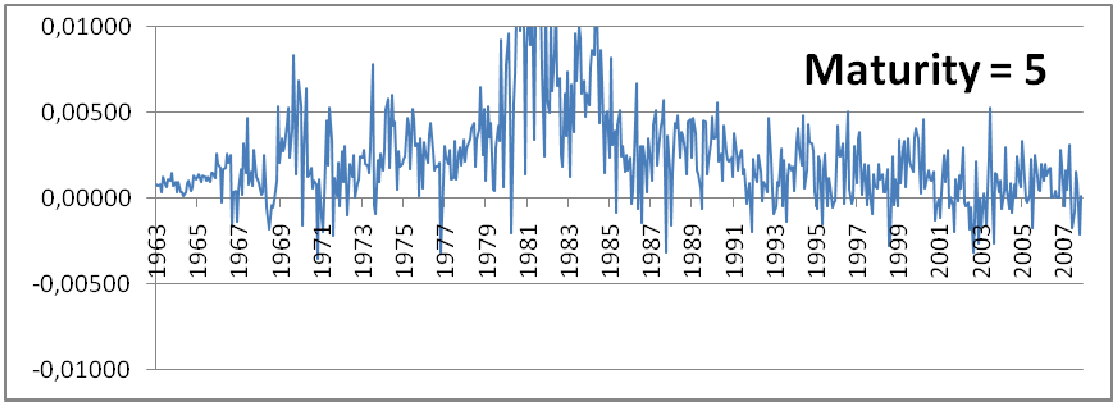
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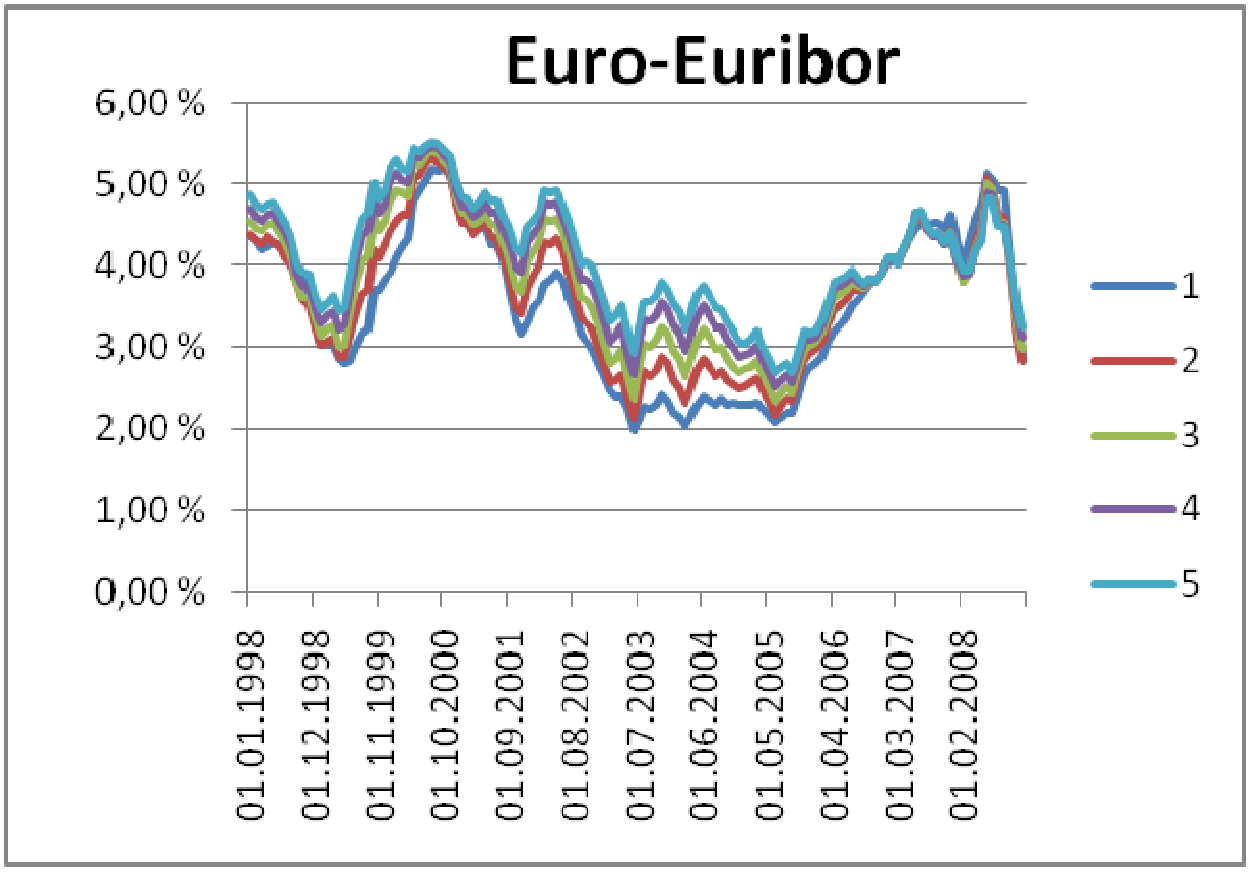

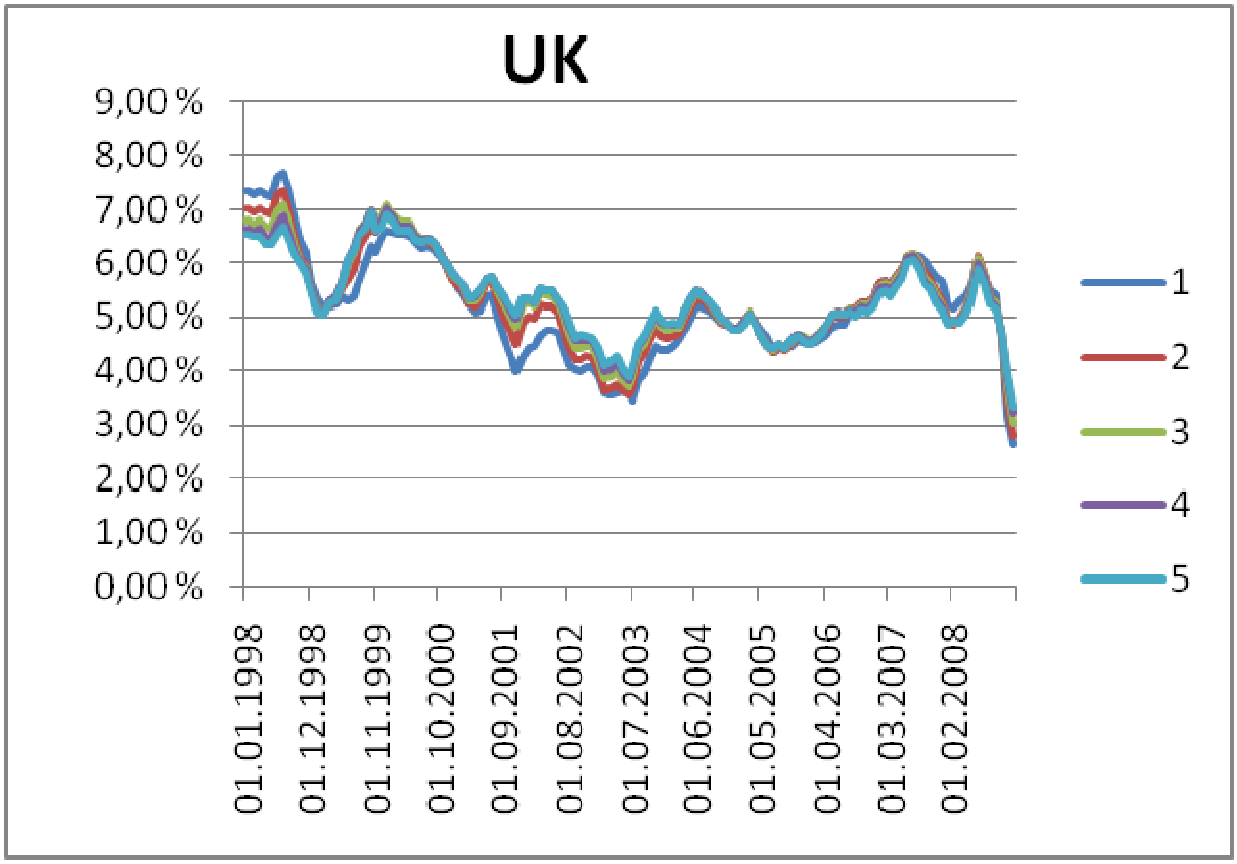
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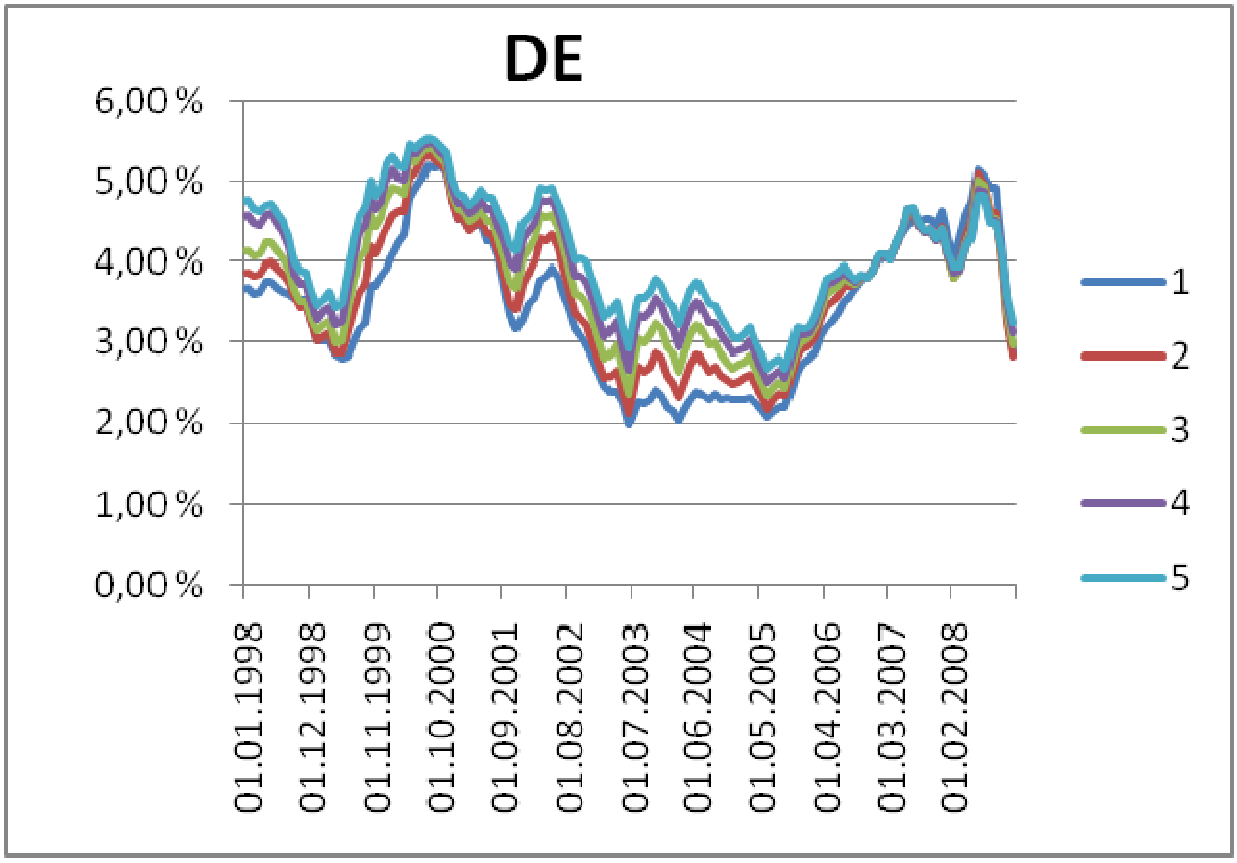
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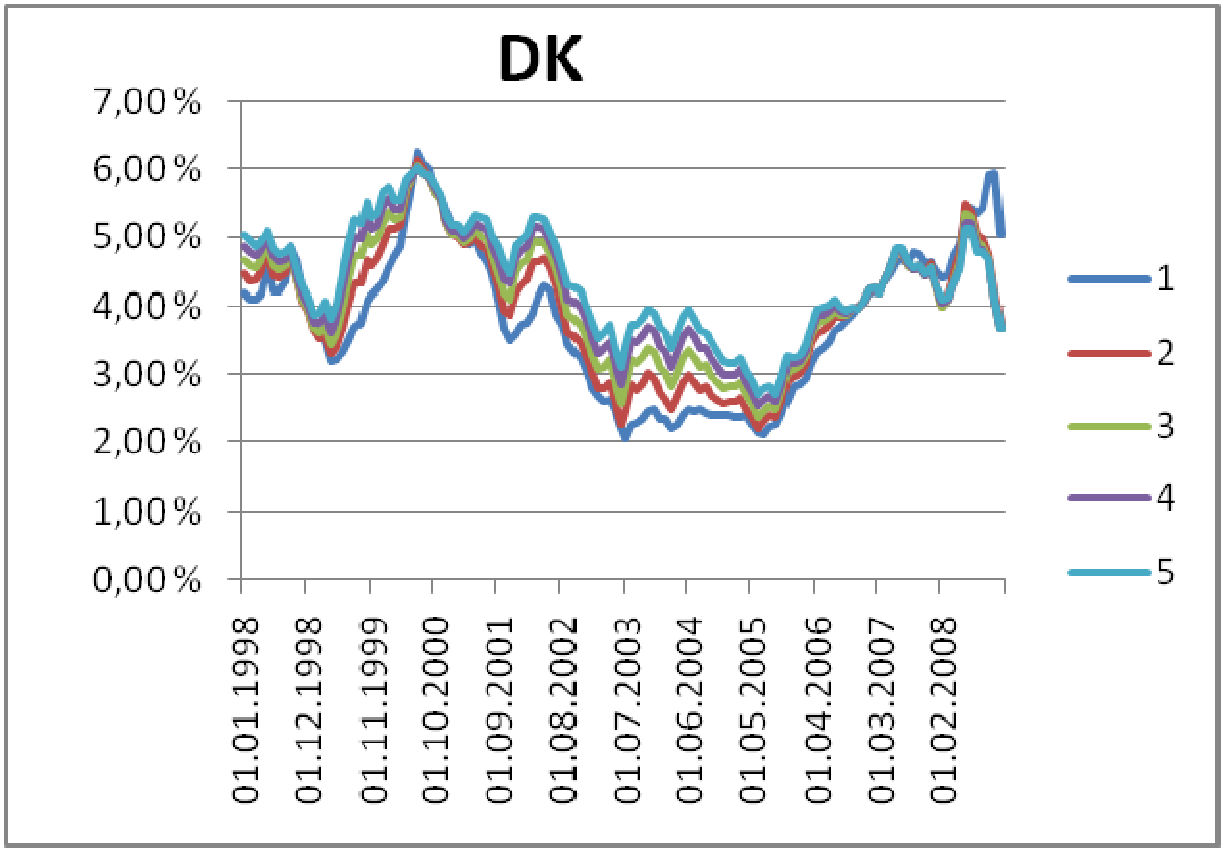

D. Data Trans ormation and Notation

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C % H &	F %& %& %& %& %&G

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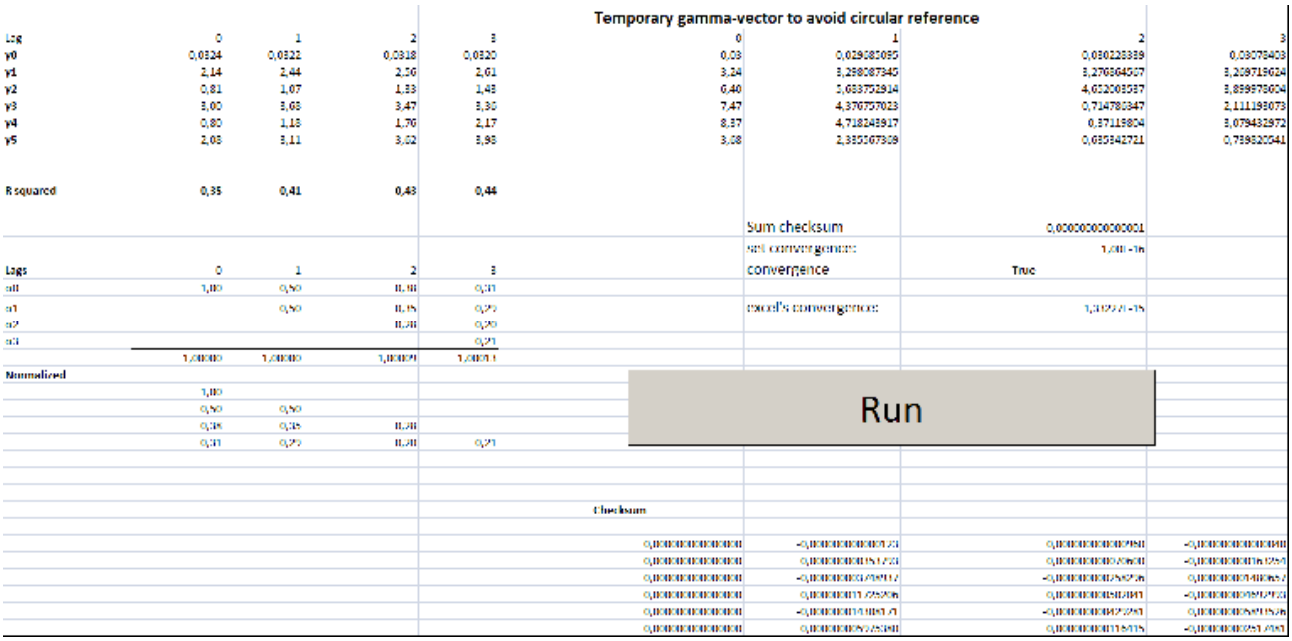
Figure A.6 **!** Multi#le **1**ags **2**stimation Procedure – **23**cel **45**A



Temporary gamma-vector to avoid circular reference

Lag	0	1	2	3	0	1	2	3
y0	0,0324	0,0322	0,0318	0,0320	0,03	0,029081095	0,030123339	0,03078403
y1	2,14	2,44	2,16	2,61	3,24	3,298087345	3,270364507	3,209719024
y2	0,81	1,07	1,33	1,48	0,40	0,683752914	4,622003587	3,899578604
y3	3,00	3,03	3,47	3,30	7,47	4,376757023	0,714780347	2,111193073
y4	0,80	1,13	1,76	2,17	8,37	4,718248917	0,37119824	3,079432872
y5	2,03	3,11	3,02	3,93	3,08	2,385167309	0,685342721	0,798320041

R squared	0,35	0,41	0,43	0,44

Sum checksum 0,000000000000001

Lags	0	1	2	3
a0	1,10	0,50	0,36	0,21
a1		0,50	0,35	0,29
a2			0,28	0,29
a3				0,21
	1,00000	1,00000	1,00000	1,00000

Normalized				
	1,10			
	0,50	0,50		
	0,36	0,35	0,28	
	0,21	0,29	0,28	0,21

Checksum				
	0,000000000000001	-0,000000000000123	0,000000000002981	-0,000000000000448
	0,000000000000001	0,000000000153723	0,000000000329691	-0,000000000763561
	0,000000000000001	-0,000000000549011	-0,000000000594526	0,000000001480967
	0,000000000000001	0,000000001725506	0,000000001518981	-0,000000002972123
	0,000000000000001	-0,000000001180147	-0,000000002972961	0,000000003711526
	0,000000000000001	0,000000002725981	0,000000001116315	-0,000000003514963

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Appendix 4* Errors in Co$'rane and Pia55esi 6!7789

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Appendix : – N%meri$al Res%lts

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(nrestri$ted $oe i$ients# R!# 2! and standard errors

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"	!=6"	!=16	!=(	!=(!	!=""	!="!		
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4	1=-6	!=41	!=/1	!=6-	!=--	!=49		
-	1=94	!=-"	!=9/	!= /	!=6	!=6"		
0ansen#0odricG								
"	!=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$' (nrestri$ted Coe i$ient E>%als t'e Restri$ted Co%nterpart

	, -./012			
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Const	!=1	#!=1	#!="	!="
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Restri$ted $oe i$ients# R!# 2! and standard errors

		Standard 1rrors			
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Expe$ted ret%rn a$tor ?@

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:%5&	#1!:(/	":!	": 6
:%2&	#4:(/	":!!	":/
:%#&	6:6!	":41	(:(
C=3 2>0.<1 %2&		9:1	4:6
R 2>0.<15	!:((		

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		1,0000000000000900	0,002666951			
2	0,27	0,84	-0,16	-0,44		1,000000999	6,77941E-06	1,1792E-12		
3	0,64	-0,11	-0,64	0,41		1,000000855	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

(nrestri$ted $oe i$ients# R!# 2! and standard errors1

Maturit8		Const	8D1E	fD"E	fD(E	fD4E	fD-E	C'i#sFuare D-E	R sFuared
	"	#1:-	#!:9!	!:46	1:1/	!:((	#!:/4	1!9:11	!:("
	(	#":49	#1:6-	!:("	":99	!:4-	#1: /	1!4:/!	!:((
	4	#(:44	#":4!	!:61	(:4/	1:(6	#":6(	1!6:!	!:(6
	-	#4:(6	#(:!1	!:9(	(:9(	1:(4	#":69	9:9"	!:((
.e,e8 7est									
	"	!:--	!:16	!:(-	!:(1	!:"1	!:"!		
	(	1:!1	!:"9	!:-	!:-1	!:(9	!:(-		
	4	1:4!	!:41	!: "	!:66	!:-"	!:4/		
	-	1: -	!:-!	!:/6	!: /	!:6(	!:6!		
0ansen#0odricG									
	"	!:6!	!:1	!:(/	!:(1	!:"!	!:19		
	(	1:((	!:(1	!: "	!:49	!:4(	!:(4		
	4	1:/(	!:44	!:9"	!:6"	!:-	!:4-		
	-	":"/	!:--	1:1!	!: 1	!:6/	!:-6		

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

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

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

		Standard 1rrors			
	1stimates	00 1"5ags	.e,e8# 7est 1/5ags	00 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(	":/(	!:-"	!:--	!:	1:64
H4	!://!	!:4(	!:44	!:-9	1:16
H-	#1:96	!:(4	!:41	!:-4	1:!!
I"D-E		4/6:(	/9:(!	4!:-(	"":99
R"	!:((				

Expe$ted ret%rn a$tor ?@

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

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

B1,. V1;,8<2						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-"	!:1" !6/!1	!:(66"4 9/	!:-19 -9	1:!!!!!!/-	4:9(6/61#!-	(:4/!661#1"	
Cur)ature	#!:4 14 6/(	!:-/-"691-	!:4"1"91-1	#!:!-! "96/	#!:-!-!/469	1:!!!!!!9	1:1 -(91#!6	# :991(91#1(	4:-6 -1#1(

			A)erage	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!!:!1 J		

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

	6amma	.e,e8#7est 1/5ags	00 Sim%lified
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 sFuared	!:"!		

	6amma	.e,e8#7est 1/5ags	00 Sim%lified
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 sFuared #ste%	!:"(		

	6amma	.e , e8# 7 est 1/ 5ags	00 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#sFuare D"E		2(,0(	17,5
R sFuared	!:"6		

Simple Spread Re)ressions

	6amma	e , e8# 7 est 1/ 5a	00 Sim%lified
C892,	#!:!(	1:1/	1:6-
:%5& :%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	00 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	00 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

(nrestri$ted $oe i$ients# R!# 2! and standard errors1

Maturit8	Const	801E	f0"E	f0(E	f04E	f0-E	C'i#sFuare 0-E	R sFuared
"	#1=""	#1=(-	"= "	#(=4(	4=46	#"="1	"6=/4	!="1
(	#"=("	#"=6	-="9	#6=((	=6(	#(=-9	((=/!	!="(
4	#(=4!	#(=/9	= !	#9=!	1!=1	#4=46	(9= !	!="-
-	#4=4	#-=!"	9=9!	#11=!6	11="1	#4=4	4(=/6	!="6

.e ,e8 7est

"	!=/!	!=44	4=44	14=-/	1/=94	/=-1
(	1=(/	!= 9	=91	"6=!-	(4=!"	1-=(!
4	1=/	1=!	1!=66	(-=((	46=4-	"!=9(
-	"=(1	1=("	1"=9	4(="/	- ="(	"-=/4

0ansen#0odricG

"	!=91	!=4	4=9-	16=""	"1=!	9=4/
(	1=-	!=/-	/=/(	"9=!1	(=/	1 =!4
4	"=1"	1=1	11=91	(9=(/	-1= (	"(=(1
-	"=6"	1=44	14=4/	4/="	6(= /	"/= 9

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

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

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

		Standard 1rrors			
	1stimates	00 1"5ags	.e ,e8# 7est 1/5ags	00 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"0-E		(6=4	(/=(	1/="	1"=
R"	!="-				

Expe$ted ret%rn a$tor ?@

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

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%e	#!: "-"1//1	#!:"!4-94 1	!:1"/11 /4	!:(6(!94!-	!:-("/6 91	1:!!!!!!994	(:4"6 91#!-
Cur)ature	#!:4 ! -(1	!:---444//	!:44(61 -(	#!:!1 (1-6	#!:-""" 9 1	1:!!!!!!!!-	6:!4!/61#!

						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!!:!! 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#7est 1/5ags	00 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'i#sFuare D4E		6: /	4:9
R sFuared #ste%	!:"!		

	6amma	.e, e8#7est 1/5ags	00 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'i#sFuare D(E		6:-9	(:-
R sFuared #	!:"1		

	6amma	.e,e8#7est1/5ags	00Sim%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 sFuared #ste%	!:"-		

Simple Spread Re)ressions

	6amma	.e,e8#7est1/5ags	00Sim%lified
C892,	#!:!(	1:-9	1:94
:%5&:%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#7est1/5ags	00Sim%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#7est1/5ags	00Sim%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;1 M.,<?
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	1:!!!!!!!!!-!	!:!!1---6((		
"	!:6	!:-"	!:!	#!:-(	1:!!!!!!!!! 6	":// 1(1#!6	#1:((/1#14	
(	!:64	#!:(1	#!:-6	!:4(	1:!!!!!!!!!("	4:/19 11#!/	#/:-1-41#14	(:"/6/1#1(
4	#!:((	!: !	#!:61	!:19	1:!!!!!!!!!!"	1:(1!(11#!9	1:11!"1#16	1:(/ /1#1 #/:("6 1#1

1rror in article¢ (rd and 4t ' com%onent e;c'anged

	":!!	(:!!	4:!!	-:!!	A)erage	Cumulati)e A)g.		
1	!:9 9-1!("	!:9966-6(	!:999969 -	!:99/9"6!4		99:(6-6 J	99:(6-6 J	
"	!:!"!""9-1	!:!!((6/(/	(:1-441#!-	!:!!1!"(/		!:616((J	99:99"/9 J	
(	!:!!!(!6/	1:9(-41#!-	(:"11/1#!-	1:1"(11#!-		!:!!9"4 J	1!!:!!"1(J	
4	":"(9"1#!6	": -4911#!6	1:!!!(1#!6	-:9!1-1#!/		!:!!!1- J	1!!:!!""/ J	
Sum	1!!:!!49 J	1!!:!!4 J	1!!:!!(4 J	99:9961 J				

**

D . Federal Reserve; 1<=:*!774 6End o "ont'9

(nrestri$ted $oe i$ients# R!# 2! and standard errors1

Maturit8		Const	8D1E	fD"E	fD(E	fD4E	fD-E	C'i#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	1:1!	9:!!	"9:-6	(9:!!	1 : (		
0ansen#0odricG									
	"	!://	!:41	(:-"	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$' (nrestri$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	00 1"5ags	.e , e8# 7 est 1/5ags	00 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

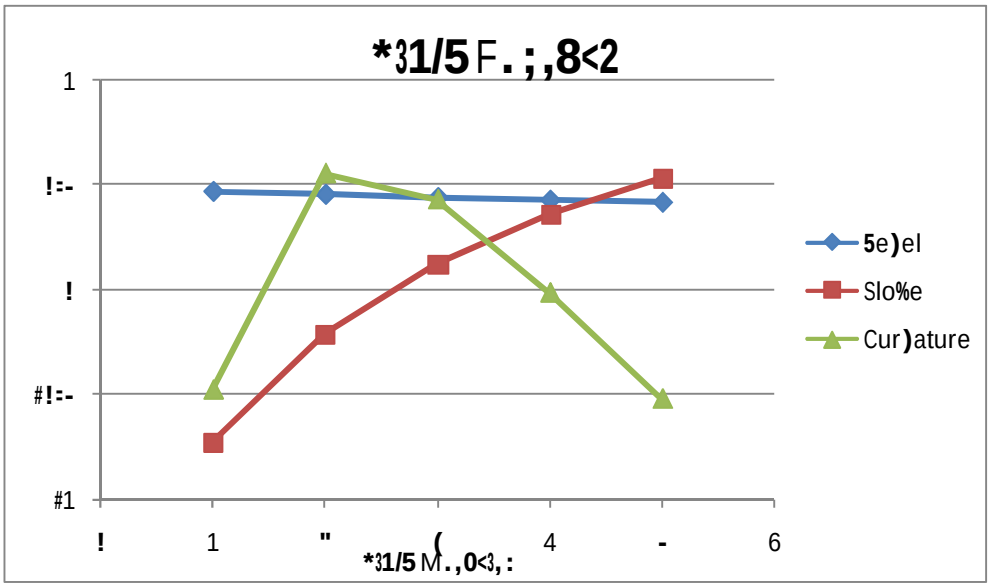
Expe$ted ret%rn a$tor ?@

	E2,34.,15 67
C892,	2,87
:%1&	8,''
:%2&	17,(0
:%#&	20,78
:%'&	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%e	#!: "-"1//1	#!:"!4-94 1	!:1"/11 /4	!:(6(!94!-	!:-("/6 91	1:!!!!!!994	(:4"6 91#!-
Cur)ature	#!:4 ! -(1	!:---444//	!:44(61 -(	#!:!1 (1-6	#!:-""" 9 1	1:!!!!!!!!-	6:!4!/61#!

					A)erage	Cumulati)e A)g.		
5e)el	!:9 !-441	!:996/-9""	!:99/6!194	!:99!4!61	!:9 /- 94	9/: ! J	9/: ! J	#1:(4!41#1"
Slo%e	!:!"996!/	!:!!"6("16	!:!!11!(!(	!:!!9"/(14	!:!"!69/"4	1:" J	99:9 J	4:/!1 1#14
Cur)e	!:!!!"""-4	!:!!!(4199	!:!!!"((1(	(: "1 1#!	!:!!!(-!-"	!:!" J	1!!:!! J	": 61 1#14
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#7est 1/5ags	00Sim%lified
Const	#!=!(	1=-6	1=9-
Slo%e	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		=69	-=-
R sFuared # ste%	!=19		

	6amma	.e,e8#7est 1/5ags	00Sim%lified
Const	#!=!(	1=-6	1=9-
5e)el	#1 =!1	/4=4/	/=!
Slo%e	!=-"	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 sFuared #	!="1		

	6amma	.e,e8#7est 1/5ags	00Sim%lified
Const	#!=!(	1=-6	1=9-
5e)el	4!=-1	(/"= 1	(-"=-!
Slo%e	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 sFuared # ste%	!="4		

Simple Spread Re)ressions

	6amma	.e ,e8#7est 1/5ags	00 Sim%lified
C892,	#!:!(	1:-9	1:94
:%5& :%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#7est 1/5ags	00 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#7est 1/5ags	00 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;1 M.,<?
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	1=!!!!!!!!!-!	!=!!1---6((			
"	!=6	!=-"	!=!	#!=-(	1=!!!!!!!!! 6	"=// 1(1#!6	#1=((/1#14		
(	!=64	#!=(1	#!=-6	!=4(	1=!!!!!!!!!("	4=/19 11#!/	#/=-1-41#14	(="/6/1#1(	
4	#!=((	!= !	#!=61	!=19	1=!!!!!!!!!!"	1=(1!(11#!9	1=11!"1#16	1=(/ /1#1	#/=("6 1#1

1rror in article((rd and 4t ' com%onent e;c 'anged

	"=!!	(=!!	4=!!	-=!!
1	!=9 9-1!("	!=9966-6(	!=999969 -	!=99/9"6!4
"	!=!"!""9-1	!=!!((6/(/	(=1-441#!-	!=!!1!"(/
(	!=!!!(!6/	1=9(-41#!-	(="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 J	99=9961 J

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

(nrestri$ted $oe i$ients# R!# 2! and standard errors1

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 7est

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

0ansen#0odricG

"	!=	!=-9	1="6	!=9-	L.UMM	L.UMM
(	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 7est

"	/ 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

0ansen#0odricG

"	!=99	!= 9	1=64	"=16	4=("	"=6-
(	"=(/	1=--	"=9!	(=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 7est

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

0ansen#0odricG

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

*

D194.<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 7est

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

0ansen#0odricG

"	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="	=1"	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

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