```
 1 . do "/var/folders/2w/hhdffn2j7vg0q3zxtrj96n6h0000gn/T//SD00622.000000"

 2 . clear

 3 . capture log close

 4 . cd "/Users/yimingzhang/Desktop"
   /Users/yimingzhang/Desktop

 5 . log using "PS2 example.log", replace
   ----------------------------------------------------------------------------------
         name:  <unnamed>
          log:  /Users/yimingzhang/Desktop/PS2 example.log
     log type:  text
    opened on:  24 Jul 2023, 23:04:55

 6 .
 7 . * Load the data
 8 . insheet using "pst2_data.csv", comma names
   (4 vars, 5,922 obs)

 9 .
10 . * Convert the date to Stata's date format
11 . gen stata_date = date(date, "YMD")

12 .
13 . * Set the time series variable
14 . tsset stata_date

   Time variable: stata_date, 14613 to 23210, but with gaps
           Delta: 1 unit

15 .
16 . * Check for heteroskedasticity
17 . tsline ret_spx

18 .
19 . * a. Estimate a CAPM style regression for Microsoft
20 . reg ret_msft ret_spx

         Source |       SS           df       MS      Number of obs   =     3,288
   -------------+----------------------------------   F(1, 3286)      =   4507.28
          Model |  .515916339         1  .515916339   Prob > F        =    0.0000
       Residual |  .376125349     3,286  .000114463   R-squared       =    0.5784
   -------------+----------------------------------   Adj R-squared   =    0.5782
          Total |  .892041687     3,287  .000271385   Root MSE        =     .0107
```

ret_msft	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
ret_spx	**1.132816**	**.0168734**	**67.14**	**0.000**	**1.099732**	**1.165899**
_cons	**.0004576**	**.0001868**	**2.45**	**0.014**	**.0000914**	**.0008238**

```
21 .
22 . * Test that the regression beta is equal to one
23 . test ret_spx == 1

 ( 1)  ret_spx = 1

       F(  1,  3286) =   61.96
            Prob > F =    0.0000

24 . test ret_spx == 0.5

 ( 1)  ret_spx = .5

       F(  1,  3286) = 1406.53
            Prob > F =    0.0000

25 .
26 . * Repeat the above steps for Tesla
27 . reg ret_tsla ret_spx
```

Source	SS	df	MS			
				Number of obs	=	**3,288**
				F(1, 3286)	=	**733.63**
Model	**.779474666**	**1**	**.779474666**	Prob > F	=	**0.0000**
Residual	**3.49135943**	**3,286**	**.001062495**	R-squared	=	**0.1825**
				Adj R-squared	=	**0.1823**
Total	**4.27083409**	**3,287**	**.001299311**	Root MSE	=	**.0326**

ret_tsla	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
ret_spx	**1.392421**	**.0514083**	**27.09**	**0.000**	**1.291626**	**1.493217**
_cons	**.001497**	**.0005691**	**2.63**	**0.009**	**.0003812**	**.0026127**

```
28 . test ret_spx == 1

 ( 1)  ret_spx = 1

       F(  1,  3286) =   58.27
            Prob > F =    0.0000
```

```
29 . test ret_spx == 0.5

 ( 1)  ret_spx = .5

       F(  1,  3286) =  301.35
            Prob > F =    0.0000

30 .
31 . * b. Test for heteroskedasticity for Microsoft
32 . reg ret_msft ret_spx

      Source |       SS           df       MS      Number of obs   =     3,288
-------------+----------------------------------   F(1, 3286)      =   4507.28
       Model |  .515916339         1  .515916339   Prob > F        =    0.0000
    Residual |  .376125349     3,286  .000114463   R-squared       =    0.5784
-------------+----------------------------------   Adj R-squared   =    0.5782
       Total |  .892041687     3,287  .000271385   Root MSE        =     .0107

------------------------------------------------------------------------------
    ret_msft | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     ret_spx |   1.132816   .0168734    67.14   0.000     1.099732    1.165899
       _cons |   .0004576   .0001868     2.45   0.014     .0000914    .0008238
------------------------------------------------------------------------------

33 . estat hettest

   Breusch–Pagan/Cook–Weisberg test for heteroskedasticity
   Assumption: Normal error terms
   Variable: Fitted values of ret_msft

   H0: Constant variance

       chi2(1) =   9.79
   Prob > chi2 = 0.0018

34 .
35 . * Correct the standard errors
36 . reg ret_msft ret_spx, robust

   Linear regression                               Number of obs     =      3,288
                                                   F(1, 3286)        =    2847.74
                                                   Prob > F          =     0.0000
                                                   R-squared         =     0.5784
                                                   Root MSE          =      .0107

------------------------------------------------------------------------------
             |               Robust
```

```
    ret_msft | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     ret_spx |   1.132816    .021228    53.36   0.000     1.091194    1.174437
       _cons |   .0004576   .0001862     2.46   0.014     .0000924    .0008227
------------------------------------------------------------------------------

37 .
38 . * Test that the corrected beta is equal to one
39 . test ret_spx == 1

 ( 1)  ret_spx = 1

       F(  1,  3286) =   39.15
            Prob > F =    0.0000

40 .
41 . * Repeat the above steps for Tesla
42 . reg ret_tsla ret_spx

      Source |       SS           df       MS      Number of obs   =     3,288
-------------+----------------------------------   F(1, 3286)      =    733.63
       Model |  .779474666         1  .779474666   Prob > F        =    0.0000
    Residual |  3.49135943     3,286  .001062495   R-squared       =    0.1825
-------------+----------------------------------   Adj R-squared   =    0.1823
       Total |  4.27083409     3,287  .001299311   Root MSE        =     .0326

------------------------------------------------------------------------------
    ret_tsla | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     ret_spx |   1.392421   .0514083    27.09   0.000     1.291626    1.493217
       _cons |    .001497   .0005691     2.63   0.009     .0003812    .0026127
------------------------------------------------------------------------------

43 . estat hettest

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of ret_tsla

H0: Constant variance

    chi2(1) =  19.74
Prob > chi2 = 0.0000

44 . reg ret_tsla ret_spx, robust

Linear regression                               Number of obs     =      3,288
                                                F(1, 3286)        =     418.95
```

```
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1825
                                                Root MSE          =      .0326

------------------------------------------------------------------------------
             |               Robust
    ret_tsla | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     ret_spx |   1.392421   .0680287    20.47   0.000     1.259039    1.525804
       _cons |    .001497   .0005666     2.64   0.008      .000386     .002608
------------------------------------------------------------------------------

45 . test ret_spx == 1

    ( 1)  ret_spx = 1

          F(  1,  3286) =   33.28
               Prob > F =    0.0000

46 .
47 . * c. Attempt to correct the standard errors through GLS for Microsoft
48 . qui reg ret_msft ret_spx, robust

49 . predict ehat, resid
   (2,634 missing values generated)

50 . gen ehat_sq = ehat^2
   (2,634 missing values generated)

51 . gen ret_spx_gls = ret_spx / sqrt(ehat_sq)
   (2,634 missing values generated)

52 . gen ret_msft_gls = ret_msft / sqrt(ehat_sq)
   (2,634 missing values generated)

53 . gen cons_gls = 1 / sqrt(ehat_sq)
   (2,634 missing values generated)

54 . reg ret_msft_gls cons_gls ret_spx_gls, noc

      Source |       SS           df       MS      Number of obs   =     3,288
-------------+----------------------------------   F(2, 3286)      >  99999.00
       Model |  8163324.07         2  4081662.03   Prob > F        =    0.0000
    Residual |  3285.63651     3,286  .999889383   R-squared       =    0.9996
-------------+----------------------------------   Adj R-squared   =    0.9996
       Total |   8166609.7     3,288  2483.76208   Root MSE        =    .99994

------------------------------------------------------------------------------
             |
```

ret_msft_gls	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
cons_gls	.0004567	9.65e-07	473.49	0.000	.0004548	.0004586
ret_spx_gls	1.133335	.0004048	2799.66	0.000	1.132541	1.134128

```
55 .
56 . * Repeat the above steps for Tesla
57 . qui reg ret_tsla ret_spx, robust

58 . predict ehat2, resid
   (2,634 missing values generated)

59 . gen ehat_sq2 = ehat2^2
   (2,634 missing values generated)

60 . gen ret_tsla_gls = ret_tsla / sqrt(ehat_sq2)
   (2,634 missing values generated)

61 . reg ret_tsla_gls cons_gls ret_spx_gls, noc
```

Source	SS	df	MS			
				Number of obs	=	3,288
				F(2, 3286)	=	0.21
Model	1959.75313	2	979.876565	Prob > F	=	0.8072
Residual	15034748.3	3,286	4575.3951	R-squared	=	0.0001
				Adj R-squared	=	-0.0005
Total	15036708.1	3,288	4573.20805	Root MSE	=	67.642

ret_tsla_gls	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
cons_gls	3.87e-06	.0000653	0.06	0.953	-.0001241	.0001318
ret_spx_gls	.0177807	.0273836	0.65	0.516	-.03591	.0714713

```
62 .
63 . * Conduct a Hausman Test for Microsoft
64 . qui reg ret_msft ret_spx

65 . est store ols

66 .
67 . qui reg ret_msft_gls cons_gls ret_spx_gls, noc

68 . est store gls

69 . suest ols gls
```

Simultaneous results for ols, gls   Number of obs = **3,288**

	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
ols_mean						
ret_spx	**1.132816**	**.0212248**	**53.37**	**0.000**	**1.091216**	**1.174416**
_cons	**.0004576**	**.0001862**	**2.46**	**0.014**	**.0000926**	**.0008225**
ols_lnvar						
_cons	**-9.075259**	**.0672333**	**-134.98**	**0.000**	**-9.207034**	**-8.943484**
gls_mean						
cons_gls	**.0004567**	**2.65e-07**	**1721.01**	**0.000**	**.0004562**	**.0004572**
ret_spx_gls	**1.133335**	**.0002816**	**4024.81**	**0.000**	**1.132783**	**1.133886**
gls_lnvar						
_cons	**-.0001106**	**.000686**	**-0.16**	**0.872**	**-.0014552**	**.001234**

```
70 . *test if constants and slopes are the same in the two specifications
71 . test ([ols_mean]_cons=[gls_mean]cons_gls) ([ols_mean]ret_spx=[gls_mean]ret_spx_g
   > ls)

    ( 1)  [ols_mean]_cons - [gls_mean]cons_gls = 0
    ( 2)  [ols_mean]ret_spx - [gls_mean]ret_spx_gls = 0

               chi2(  2) =    0.00
             Prob > chi2 =    0.9997

72 .
73 . * Repeat the above steps for Tesla
74 . qui reg ret_tsla ret_spx

75 . est store ols

76 . qui reg ret_tsla_gls cons_gls ret_spx_gls, noc

77 . est store gls

78 . suest ols gls
```

Simultaneous results for ols, gls   Number of obs = **3,288**

	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]

```
------------------------------------------------------------------------------
ols_mean     |
     ret_spx |   1.392421   .0680183    20.47   0.000     1.259108    1.525735
       _cons |    .001497   .0005666     2.64   0.008     .0003866    .0026074
-------------+----------------------------------------------------------------
ols_lnvar    |
       _cons |  -6.847135   .0504303  -135.77   0.000    -6.945977   -6.748294
-------------+----------------------------------------------------------------
gls_mean     |
    cons_gls |   3.87e-06   3.86e-06     1.00   0.315    -3.69e-06    .0000114
 ret_spx_gls |   .0177807   .0093345     1.90   0.057    -.0005146     .036076
-------------+----------------------------------------------------------------
gls_lnvar    |
       _cons |   8.428448   .7042744    11.97   0.000     7.048096    9.808801
------------------------------------------------------------------------------

79 . *test if constants and slopes are the same in the two specifications
80 . test ([ols_mean]_cons=[gls_mean]cons_gls) ([ols_mean]ret_spx=[gls_mean]ret_spx_g
   > ls)

    ( 1)  [ols_mean]_cons - [gls_mean]cons_gls = 0
    ( 2)  [ols_mean]ret_spx - [gls_mean]ret_spx_gls = 0

              chi2(  2) =  405.43
            Prob > chi2 =    0.0000

81 .
82 . * d. Check the stability of the betas through the sample for Microsoft
83 .
84 . gen year = substr(date, 1, 4)

85 . destring year, replace
   year: all characters numeric; replaced as int

86 .
87 . reg ret_msft ret_spx, robust

   Linear regression                               Number of obs     =      3,288
                                                   F(1, 3286)        =    2847.74
                                                   Prob > F          =     0.0000
                                                   R-squared         =     0.5784
                                                   Root MSE          =      .0107

------------------------------------------------------------------------------
             |               Robust
    ret_msft | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     ret_spx |   1.132816    .021228    53.36   0.000     1.091194    1.174437
```

```
       _cons |   .0004576   .0001862     2.46   0.014     .0000924    .0008227
------------------------------------------------------------------------------

88 . xi i.year*ret_spx
   i.year            _Iyear_2000-2023    (naturally coded; _Iyear_2000 omitted)
   i.year*ret_spx    _IyeaXret_#         (coded as above)

89 . drop _Iyear*

90 . reg ret_msft ret_spx _I*, robust
   note: _IyeaXret_2014 omitted because of collinearity.
   note: _IyeaXret_2015 omitted because of collinearity.
   note: _IyeaXret_2016 omitted because of collinearity.
   note: _IyeaXret_2017 omitted because of collinearity.
   note: _IyeaXret_2018 omitted because of collinearity.
   note: _IyeaXret_2019 omitted because of collinearity.
   note: _IyeaXret_2020 omitted because of collinearity.
   note: _IyeaXret_2021 omitted because of collinearity.
   note: _IyeaXret_2022 omitted because of collinearity.
   note: _IyeaXret_2023 omitted because of collinearity.

   Linear regression                               Number of obs     =      3,288
                                                   F(14, 3273)       =     323.94
                                                   Prob > F          =     0.0000
                                                   R-squared         =     0.5929
                                                   Root MSE          =     .01053

--------------------------------------------------------------------------------
               |               Robust
      ret_msft | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
---------------+----------------------------------------------------------------
       ret_spx |   .8883665   .0648695    13.69   0.000     .7611776    1.015555
_IyeaXret_2001 |  -.0558922   .0740158    -0.76   0.450    -.2010141    .0892297
_IyeaXret_2002 |   .1221236   .1013222     1.21   0.228    -.0765377    .3207849
_IyeaXret_2003 |   .0774573   .1471983     0.53   0.599    -.2111529    .3660674
_IyeaXret_2004 |   .2840773   .1325609     2.14   0.032     .0241665    .5439881
_IyeaXret_2005 |   .3295029   .0959274     3.43   0.001      .141419    .5175867
_IyeaXret_2006 |   .2371338   .0888875     2.67   0.008     .0628531    .4114145
_IyeaXret_2007 |   .5471484   .1181707     4.63   0.000     .3154523    .7788445
_IyeaXret_2008 |   .5565243   .0888458     6.26   0.000     .3823253    .7307233
_IyeaXret_2009 |   .2061779   .0825341     2.50   0.013     .0443542    .3680016
_IyeaXret_2010 |    .393908   .1032026     3.82   0.000     .1915597    .5962563
_IyeaXret_2011 |   .3192717   .0779272     4.10   0.000     .1664806    .4720627
_IyeaXret_2012 |   .4392827   .0868361     5.06   0.000     .2690241    .6095412
_IyeaXret_2013 |   .5919075   .4338843     1.36   0.173    -.2588048     1.44262
_IyeaXret_2014 |          0  (omitted)
_IyeaXret_2015 |          0  (omitted)
_IyeaXret_2016 |          0  (omitted)
```

```
_IyeaXret_2017 |          0  (omitted)
_IyeaXret_2018 |          0  (omitted)
_IyeaXret_2019 |          0  (omitted)
_IyeaXret_2020 |          0  (omitted)
_IyeaXret_2021 |          0  (omitted)
_IyeaXret_2022 |          0  (omitted)
_IyeaXret_2023 |          0  (omitted)
         _cons |   .0004532   .0001838     2.47   0.014     .0000928    .0008136
--------------------------------------------------------------------------------

91 .
92 . * Repeat the above steps for Tesla
93 . reg ret_tsla ret_spx, robust

Linear regression                               Number of obs     =      3,288
                                                F(1, 3286)        =     418.95
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1825
                                                Root MSE          =      .0326

------------------------------------------------------------------------------
             |               Robust
    ret_tsla | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     ret_spx |   1.392421   .0680287    20.47   0.000     1.259039    1.525804
       _cons |    .001497   .0005666     2.64   0.008      .000386     .002608
------------------------------------------------------------------------------

94 . xi i.year*ret_spx
   i.year            _Iyear_2000-2023    (naturally coded; _Iyear_2000 omitted)
   i.year*ret_spx    _IyeaXret_#         (coded as above)

95 . drop _Iyear*

96 . reg ret_tsla ret_spx _I*, robust
   note: _IyeaXret_2014 omitted because of collinearity.
   note: _IyeaXret_2015 omitted because of collinearity.
   note: _IyeaXret_2016 omitted because of collinearity.
   note: _IyeaXret_2017 omitted because of collinearity.
   note: _IyeaXret_2018 omitted because of collinearity.
   note: _IyeaXret_2019 omitted because of collinearity.
   note: _IyeaXret_2020 omitted because of collinearity.
   note: _IyeaXret_2021 omitted because of collinearity.
   note: _IyeaXret_2022 omitted because of collinearity.
   note: _IyeaXret_2023 omitted because of collinearity.

Linear regression                               Number of obs     =      3,288
                                                F(14, 3273)       =      54.96
```

```
                                                  Prob > F          =     0.0000
                                                  R-squared         =     0.1950
                                                  Root MSE          =     .03241
```

ret_tsla	Coefficient	Robust std. err.	t	P>|t|	[95% conf.	interval]
ret_spx	1.124074	.2672483	4.21	0.000	.6000834	1.648065
_IyeaXret_2001	.1318168	.2950776	0.45	0.655	-.4467386	.7103722
_IyeaXret_2002	.0982042	.3529913	0.28	0.781	-.593902	.7903104
_IyeaXret_2003	.7076956	.4085712	1.73	0.083	-.0933854	1.508777
_IyeaXret_2004	.0966198	.3206588	0.30	0.763	-.5320924	.725332
_IyeaXret_2005	.1881156	.3089784	0.61	0.543	-.4176949	.7939261
_IyeaXret_2006	-.2784742	.3234865	-0.86	0.389	-.9127307	.3557822
_IyeaXret_2007	.3635275	.3362665	1.08	0.280	-.2957867	1.022842
_IyeaXret_2008	.1637751	.3402845	0.48	0.630	-.503417	.8309671
_IyeaXret_2009	-.0174276	.3244096	-0.05	0.957	-.6534939	.6186387
_IyeaXret_2010	1.184405	.4157287	2.85	0.004	.3692902	1.99952
_IyeaXret_2011	.7936406	.3076077	2.58	0.010	.1905175	1.396764
_IyeaXret_2012	.5121882	.3136637	1.63	0.103	-.1028088	1.127185
_IyeaXret_2013	2.080545	1.019302	2.04	0.041	.0820114	4.079079
_IyeaXret_2014	0	(omitted)				
_IyeaXret_2015	0	(omitted)				
_IyeaXret_2016	0	(omitted)				
_IyeaXret_2017	0	(omitted)				
_IyeaXret_2018	0	(omitted)				
_IyeaXret_2019	0	(omitted)				
_IyeaXret_2020	0	(omitted)				
_IyeaXret_2021	0	(omitted)				
_IyeaXret_2022	0	(omitted)				
_IyeaXret_2023	0	(omitted)				
_cons	.0014121	.0005669	2.49	0.013	.0003005	.0025237

```
97 .
   end of do-file

98 .
```