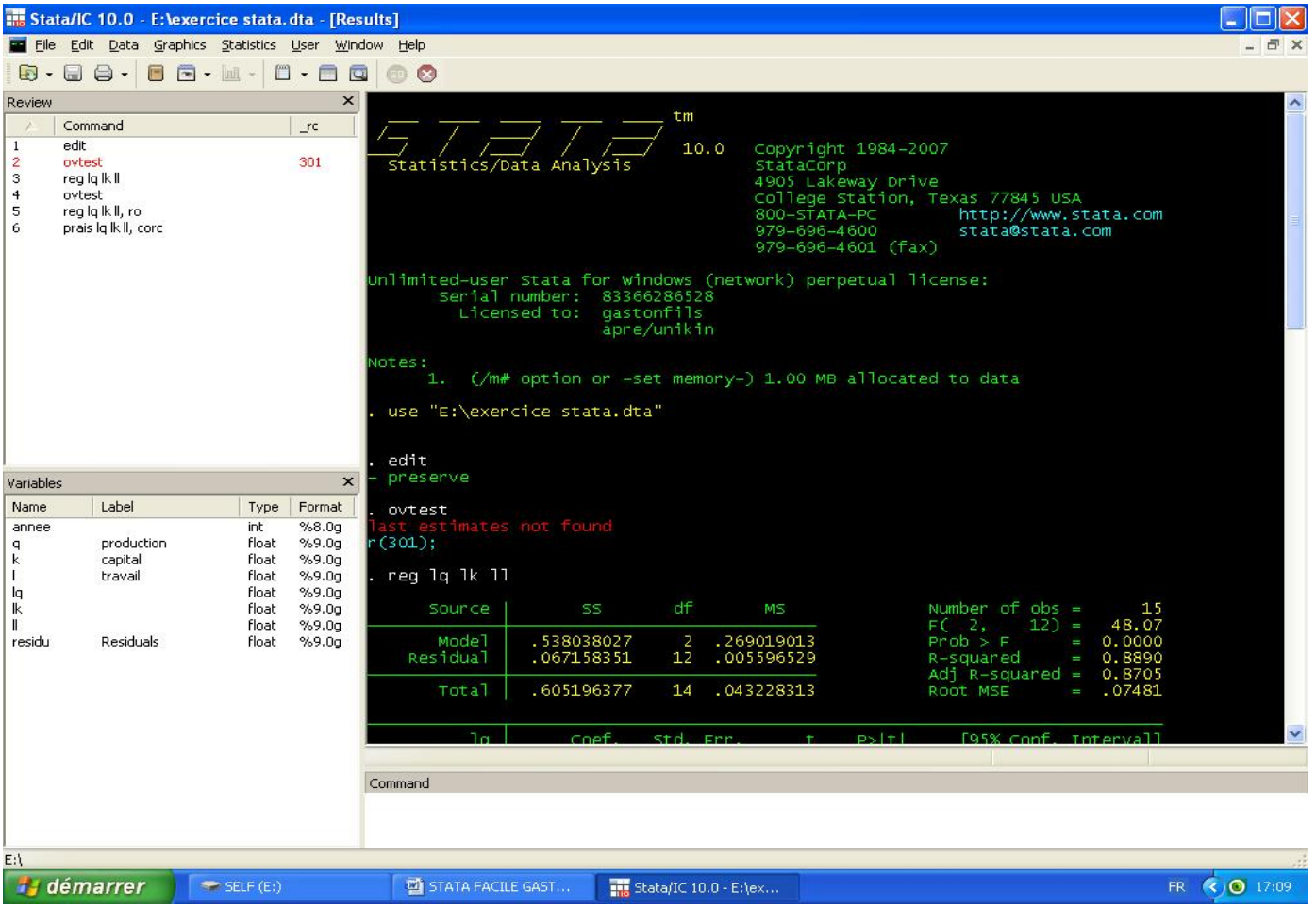


Ouverture de la base des données

```
. edit
(4 vars, 15 obs pasted into editor)
- preserve
```

Déclaration sur STATA : Cas de l'Analyse des données temporelles

```
. tsset annee
        time variable:  annee, 1958 to 1972
                delta:  1 unit
```

Opération de renommer les variables

```
. gen lq=log(q)
. gen lk=log(k)
. gen ll=log(l)
```

Obtention des Statistiques Déscriptives

```
. sum lq lk ll, detail
```

```
                            lq
-------------------------------------------------------------
      Percentiles      Smallest
 1%     9.717622       9.717622
 5%     9.717622       9.770601
10%     9.770601       9.912011       Obs                  15
25%     9.923584       9.923584       Sum of Wgt.          15

50%     10.18361                      Mean           10.09653
                       Largest        Std. Dev.      .2079142
75%     10.27627       10.27627
90%     10.30576       10.28471       Variance       .0432283
95%     10.35888       10.30576       Skewness      -.4814514
```

```
99%     10.35888       10.35888       Kurtosis       1.850953

 lk
-------------------------------------------------------------
      Percentiles      Smallest
 1%     5.587249       5.587249
 5%     5.587249        5.59024
10%      5.59024        5.59731       Obs                  15
25%     5.614587       5.614587       Sum of Wgt.          15

50%     5.663308                      Mean           5.659445
                       Largest       Std. Dev.      .0516968
75%     5.706113       5.706113
90%     5.719328       5.716041       Variance       .0026726
95%     5.728475       5.719328       Skewness      -.1089752
99%     5.728475       5.728475       Kurtosis       1.41219

                            ll
-------------------------------------------------------------
      Percentiles      Smallest
 1%     9.787162       9.787162
 5%     9.787162       9.803491
10%     9.803491       9.813114       Obs                  15
25%     9.860961       9.860961       Sum of Wgt.          15

50%     10.06242                      Mean           10.11068
                       Largest       Std. Dev.      .2734716
75%     10.36047       10.36047
90%       10.458       10.41854       Variance       .0747867
95%     10.64052         10.458       Skewness       .4385866
99%     10.64052       10.64052       Kurtosis       1.95489
```

Test de Comparaison des moyennes

```
. ttest lq=ll
Paired t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      lq |      15    10.09653    .0536832    .2079142    9.981396    10.21167
      ll |      15    10.11068    .0706101    .2734716    9.959236    10.26212
---------+--------------------------------------------------------------------
    diff |      15   -.0141446    .0318136    .1232136   -.0823781    .0540888
------------------------------------------------------------------------------
     mean(diff) = mean(lq - ll)                                      t =  -0.4446
 Ho: mean(diff) = 0                               degrees of freedom =       14

 Ha: mean(diff) < 0           Ha: mean(diff) != 0           Ha: mean(diff) > 0
 Pr(T < t) = 0.3317         Pr(|T| > |t|) = 0.6634          Pr(T > t) = 0.6683
```

Test de Comparaison des variances

```
. sdtest lq=ll

Variance ratio test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      lq |      15    10.09653    .0536832    .2079142    9.981396    10.21167
      ll |      15    10.11068    .0706101    .2734716    9.959236    10.26212
---------+--------------------------------------------------------------------
combined |      30    10.10361    .0435984    .2387981    10.01444    10.19278
------------------------------------------------------------------------------
    ratio = sd(lq) / sd(ll)                                      f =   0.5780
Ho: ratio = 1                                degrees of freedom =   14, 14

    Ha: ratio < 1               Ha: ratio != 1                 Ha: ratio > 1
  Pr(F < f) = 0.1583         2*Pr(F < f) = 0.3167           Pr(F > f) = 0.8417
```

Obtention des Coéfficients de Corrélation

```
. corr lq lk ll
(obs=15)
```

	lq	lk	ll
lq	1.0000		
lk	0.8221	1.0000	
ll	0.9043	0.6976	1.0000

Distribution de Normalité des séries

```
. sktest lk ll
```

Skewness/Kurtosis tests for Normality

Variable	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
lk	0.825	0.009	6.26	0.0438
ll	0.379	0.338	1.93	0.3811

Visualisation graphique des données

```
. two scatter lq lk
. two scatter lq ll
```

Estimation par OLS (Ordinary Least Squared)ou Moindres Carrées Ordinaire (MCO)

. reg lq lk ll

```
      Source |       SS       df       MS              Number of obs =      15
-------------+------------------------------           F(  2,    12) =   48.07
       Model |  .538038027     2  .269019013           Prob > F      =  0.0000
    Residual |  .067158351    12  .005596529           R-squared     =  0.8890
-------------+------------------------------           Adj R-squared =  0.8705
       Total |  .605196377    14  .043228313           Root MSE      =  .07481

------------------------------------------------------------------------------
          lq |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          lk |   1.498767   .5398018     2.78   0.017     .3226405    2.674894
          ll |   .4898585   .1020435     4.80   0.000     .2675249    .7121922
       _cons |  -3.338459   2.449504    -1.36   0.198    -8.675471    1.998552
------------------------------------------------------------------------------
```

Obtention de la matrice de Variance-Covariance

. vce

```
Covariance matrix of coefficients of regress model

        e(V) |          lk          ll       _cons
-------------+------------------------------------
          lk |   .08382117
          ll |  -.00421456   .00550096
       _cons |  -.43267403  -.03277069   2.7956766
```

Détection des violations d'hypthèses des MCO(OLS)

Test d'autocorrélation des erreurs

-si DW supérieur à 2 (Décision : Présence d'autocorrélation négative)
-si DW égale à 2 (Décision : Absence d'autocorrélation)
-si DW inférieur à 2 (Décision : Présence d'autocorrélation positive)

. dwstat

```
Durbin-Watson d-statistic(  3,    15) =  .8910877
```

. durbina

H0: Absence d'autocorrélation des erreurs (si Prob_X² est sup à 0.05, Décision : Acceptation de l' Hypothèse nulle)
H1: Présence d'autocorrélation des erreurs (si Prob_X² est sup à 0.05, Décision : Rejet Hypothèse nulle)

```
Durbin's alternative test for autocorrelation
------------------------------------------------------------------------------
    lags(p)  |          chi2               df                 Prob > chi2
-------------+----------------------------------------------------------------
       1     |          1.883               1                   0.1700
------------------------------------------------------------------------------
                        H0: no serial correlation
```

. bgodfrey

H0: Absence d'autocorrélation des erreurs (si Prob_X² est sup à 0.05, Décision : Acceptation de l' Hypothèse nulle)
H1: Présence d'autocorrélation des erreurs (si Prob_X² est sup à 0.05, Décision : Rejet Hypothèse nulle)

```
Breusch-Godfrey LM test for autocorrelation
------------------------------------------------------------------------------
    lags(p)  |          chi2               df                 Prob > chi2
-------------+----------------------------------------------------------------
       1     |          2.192               1                   0.1387
------------------------------------------------------------------------------
                        H0: no serial correlation
```

Test d'Hétéroscédasticité

H0: Homoscédasticité des erreurs ou variance des erreurs constante (si Prob_X² est sup à 0.05, Décision : Acceptation de l'Hypothèse nulle)

H1: Hétéroscédasticité des erreurs ou variance des erreurs constante (si Prob_X² est infér ou égale à 0.05, Décision : Rejet Hypothèse nulle)

```
. hettest
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lq

         chi2(1)      =     4.65
         Prob > chi2  =   0.0310
```

Test de Normality des Résidus

H0: les erreurs sont normalement distribuées (si Prob_X² est sup à 0.05, Décision : Acceptation de l'Hypothèse nulle)

H1: les erreurs ne sont pas normalement distribuées (si Prob_X² est infér ou égale à 0.05, Décision : Rejet Hypothèse nulle)

```
. quietly reg lq lk ll
. predict residu, resid
. sktest residu
                    Skewness/Kurtosis tests for Normality
                                                   ------- joint ------
    Variable |  Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+-------------------------------------------------------
      residu |      0.109         0.398           3.71        0.1562
```

Test de Ramsey-Reset (il teste l'omission d'une vriable explicative pertinente)

H0: le modèle est bien spécifié (si Prob_X² est sup à 0.05, Décision : Acceptation de l'Hypothèse nulle)

H1: le modèle est mal spécifié (si Prob_X² est infér ou égale à 0.05, Décision : Rejet Hypothèse nulle)

```
. ovtest
Ramsey RESET test using powers of the fitted values of lq
       Ho:  model has no omitted variables
                  F(3, 9) =      3.89
                Prob > F =      0.0493
```

CORRECTION DES HYPOTHESES VIOLEES

Correction de l'Hétéroscédasticité (Méthode d'Eicker-White = Méthode des écarts robustes)

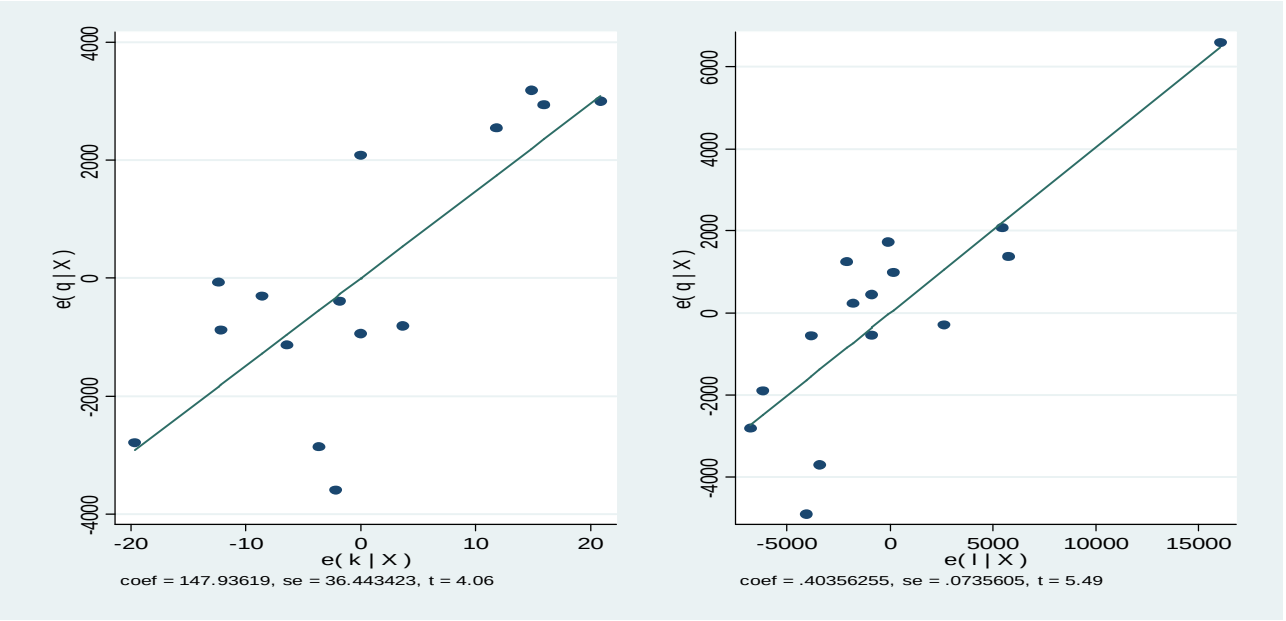
```
. reg lq lk ll, robust

Linear regression                               Number of obs =      15
                                                F(  2,    12) =   43.60
                                                Prob > F      =  0.0000
                                                R-squared     =  0.8890
                                                Root MSE      =  .07481

------------------------------------------------------------------------------
             |               Robust
          lq |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          lk |   1.498767   .2895189     5.18   0.000     .8679601    2.129575
          ll |   .4898585   .0741685     6.60   0.000     .3282593    .6514578
       _cons |  -3.338459   1.672028    -2.00   0.069    -6.981495    .3045759
------------------------------------------------------------------------------
```

Correction définitive de l'Autocorrélation des erreurs

```
. prais lq lk ll, corc
Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.3657
Iteration 2:  rho = 0.3987
Iteration 3:  rho = 0.4107
Iteration 4:  rho = 0.4155
Iteration 5:  rho = 0.4175
Iteration 6:  rho = 0.4183
Iteration 7:  rho = 0.4187
Iteration 8:  rho = 0.4188
Iteration 9:  rho = 0.4189
Iteration 10:  rho = 0.4189
Iteration 11:  rho = 0.4189
Iteration 12:  rho = 0.4189
Iteration 13:  rho = 0.4189
Iteration 14:  rho = 0.4189

Cochrane-Orcutt AR(1) regression -- iterated estimates

      Source |       SS       df       MS              Number of obs =      14
-------------+------------------------------           F(  2,    11) =   26.06
       Model |  .127422686     2  .063711343           Prob > F      =  0.0001
    Residual |  .026887722    11  .002444338           R-squared     =  0.8258
-------------+------------------------------           Adj R-squared =  0.7941
       Total |  .154310409    13  .011870031           Root MSE      =  .04944

------------------------------------------------------------------------------
          lq |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          lk |    1.17154   .4658828     2.51   0.029     .1461386    2.196941
          ll |   .4308224   .0936668     4.60   0.001     .2246631    .6369817
       _cons |  -.8645556   2.314019    -0.37   0.716    -5.957677    4.228566
-------------+----------------------------------------------------------------
         rho |   .4189009
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.891088
Durbin-Watson statistic (transformed) 2.382916
```

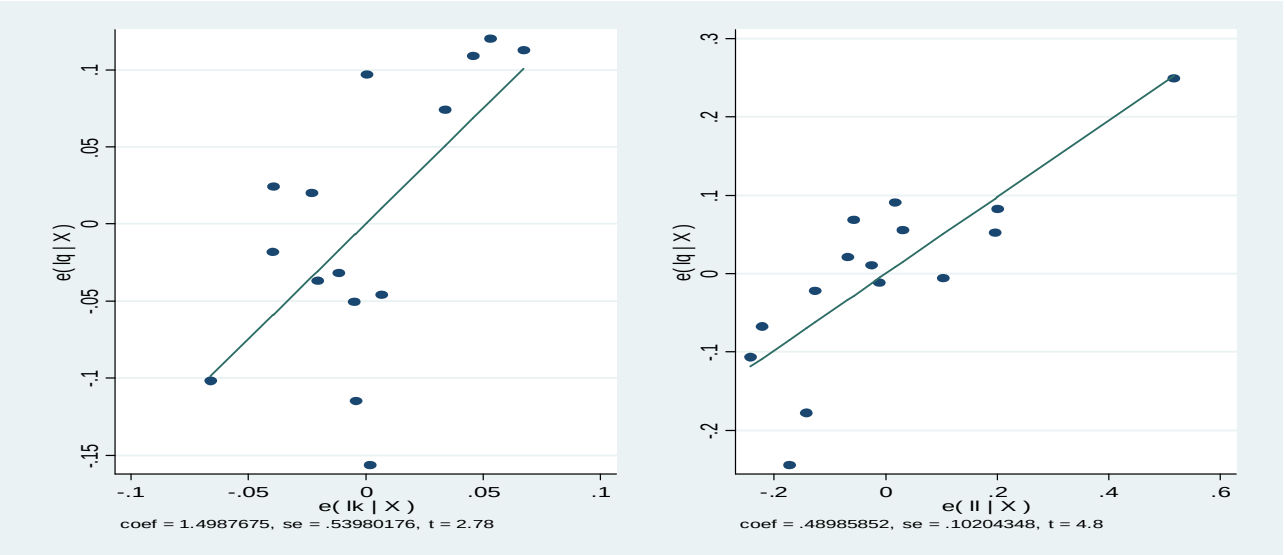
Visualisation graphique de la droite de regrssion (Avant)

```
.quietly reg q k l
.avplots
```

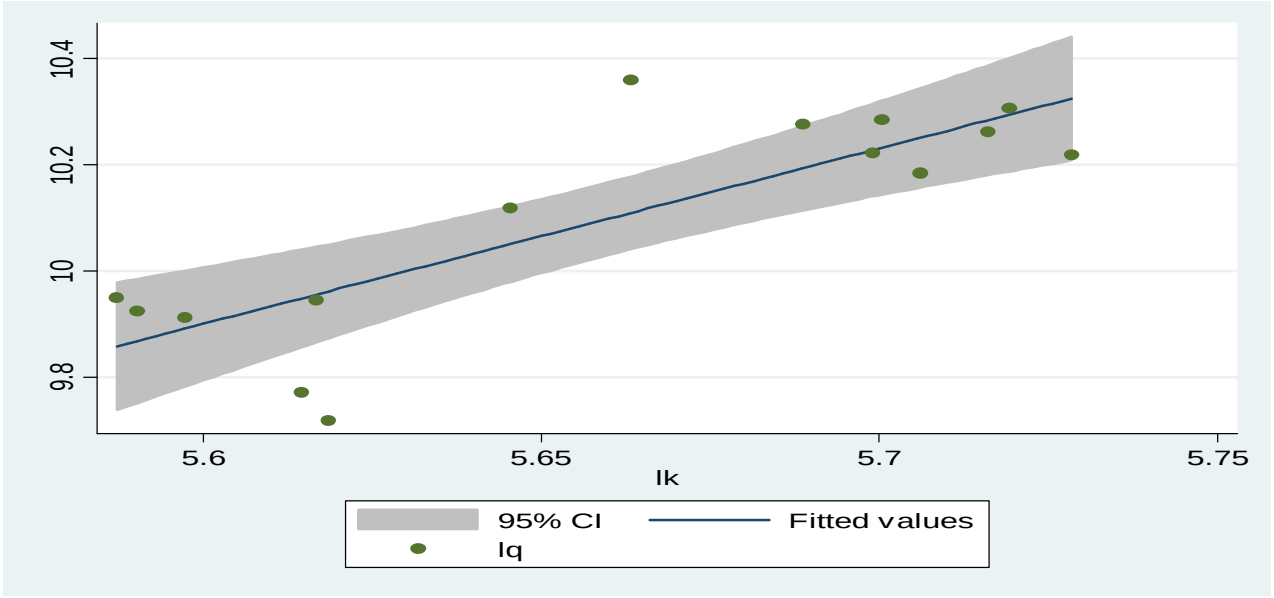


Visualisation graphique de la droite de regression (après)

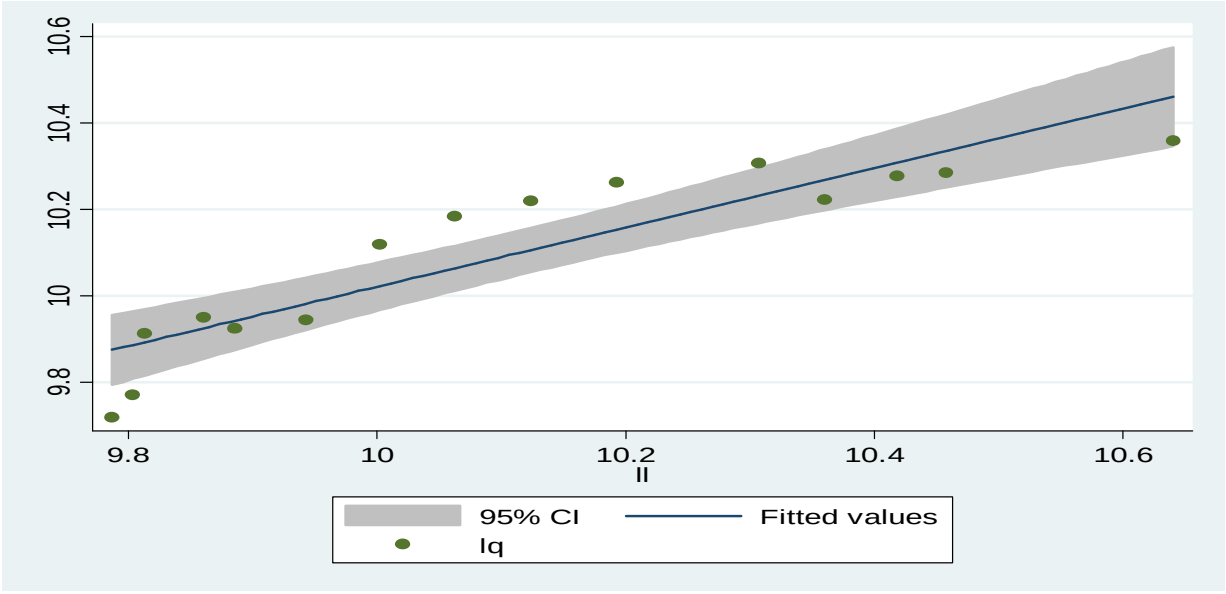
```
.quietly reg lq lk ll, robust
.avplots
```



```
. twoway (lfitci lq lk) (scatter lq lk)
```

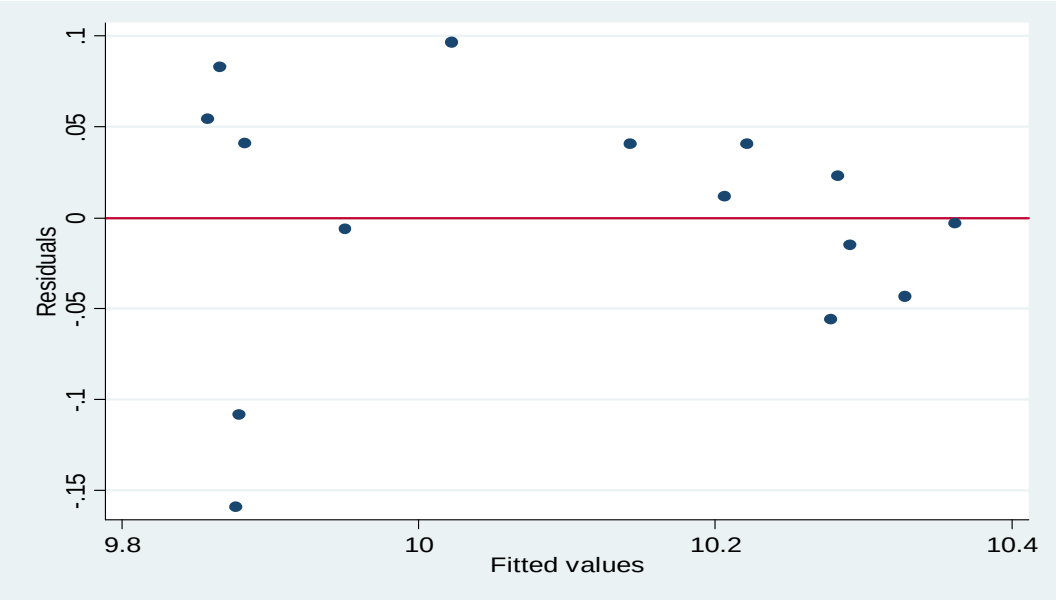



```
. twoway (lfitci lq ll) (scatter lq ll)
```



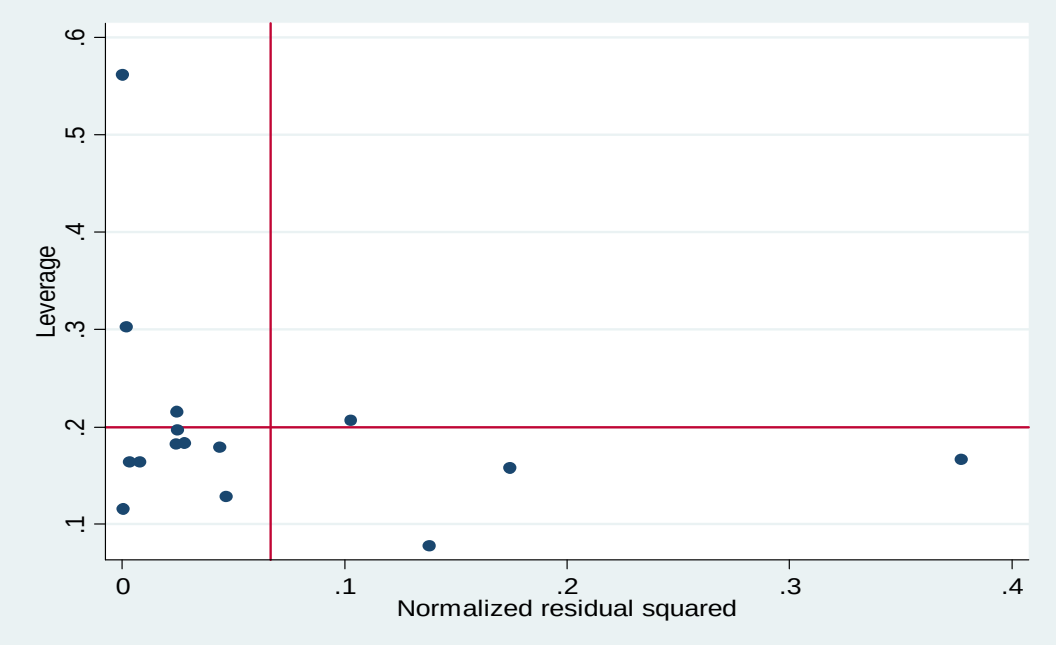
Comment réperer les observations abérrantes de l'erreur homoscédastique

```
.quietly reg lq lk ll, robust
. rvfplot, yline(0)
```



Comment réperer les observations extrêmes

```
.quietly reg lq lk ll
.lvr2plot
```



```
. edit
```

(ouvrir DATA EDITOR et taper la suite des années pour la prévision hors échantillon)

```
- preserve
- set obs 16
- replace annee = 1973 in 16
- set obs 17
- replace annee = 1974 in 17
- preserve quietly reg lq lk ll, ro
. predict lq2, xb
. gen prevlq1=exp(lq1)
. list annee lq2 prevlq1 in 15/17
```

	annee	lq2	prevlq1
15.	1972	10.36187	31630.24
16.	1973	.	.
17.	1974	.	.

Base des Données de l'étude

	annee	q	k	l	lq	lk	ll	residu
1	1958	16607.7	275.5	17803.7	9.717622	5.618587	9.787162	-.1591995
2	1959	17511.3	274.4	18096.8	9.770601	5.614587	9.803491	-.1082227
3	1960	20171.2	269.7	18271.8	9.912011	5.59731	9.813114	.0543668
4	1961	20932.9	267	19167.3	9.949078	5.587249	9.860961	.0830746
5	1962	20406	267.8	19647.6	9.923584	5.59024	9.885711	.0409733
6	1963	20831.6	275	20803.5	9.944226	5.616771	9.942877	-.0061512
7	1964	24806.3	283	22076.6	10.11885	5.645447	10.00227	.0964012
8	1965	26465.8	300.7	23445.2	10.18361	5.706113	10.06242	.0407689
9	1966	27403	307.5	24939	10.21841	5.728475	10.12419	.011795
10	1967	28628.7	303.7	26713.7	10.26217	5.716041	10.19293	.0405142
11	1968	29904.5	304.7	29957.8	10.30576	5.719328	10.30754	.0230425
12	1969	27508.2	298.6	31585.9	10.22224	5.699105	10.36047	-.0560964
13	1970	29035.5	295.5	33474.5	10.27627	5.688669	10.41854	-.0148676
14	1971	29281.5	299	34821.8	10.28471	5.700444	10.458	-.0434093
15	1972	31535.8	288.1	41794.3	10.35888	5.663308	10.64052	-.0029898

	l	lq	lk	ll	residu	lq1	prevlq	lq2	prevlq1	lqf	lqh
1	17803.7	9.717622	5.618587	9.787162	-.1591995	9.876822	19473.73	9.876822	19473.73	9.876822	-.1591995
2	18096.8	9.770601	5.614587	9.803491	-.1082227	9.878824	19512.77	9.878824	19512.77	9.878824	-.1082227
3	18271.8	9.912011	5.59731	9.813114	.0543668	9.857644	19103.83	9.857644	19103.83	9.857644	.0543668
4	19167.3	9.949078	5.587249	9.860961	.0830746	9.866003	19264.19	9.866003	19264.19	9.866003	.0830746
5	19647.6	9.923584	5.59024	9.885711	.0409733	9.88261	19586.78	9.88261	19586.78	9.88261	.0409733
6	20803.5	9.944226	5.616771	9.942877	-.0061512	9.950377	20960.13	9.950377	20960.13	9.950377	-.0061512
7	22076.6	10.11885	5.645447	10.00227	.0964012	10.02245	22526.58	10.02245	22526.58	10.02245	.0964012
8	23445.2	10.18361	5.706113	10.06242	.0407689	10.14284	25408.53	10.14284	25408.53	10.14284	.0407689
9	24939	10.21841	5.728475	10.12419	.011795	10.20661	27081.68	10.20661	27081.68	10.20661	.011795
10	26713.7	10.26217	5.716041	10.19293	.0405142	10.22165	27492.02	10.22165	27492.02	10.22165	.0405142
11	29957.8	10.30576	5.719328	10.30754	.0230425	10.28272	29223.3	10.28272	29223.3	10.28272	.0230425
12	31585.9	10.22224	5.699105	10.36047	-.0560964	10.27834	29095.41	10.27834	29095.41	10.27834	-.0560964
13	33474.5	10.27627	5.688669	10.41854	-.0148676	10.29114	29470.42	10.29114	29470.42	10.29114	-.0148676
14	34821.8	10.28471	5.700444	10.458	-.0434093	10.32812	30580.57	10.32812	30580.57	10.32812	-.0434093
15	41794.3	10.35888	5.663308	10.64052	-.0029898	10.36187	31630.24	10.36187	31630.24	10.36187	-.0029898