

```
. use C:\Users\Sabrina\Desktop\econometrics\iv\grilic.dta,clear
```

```
. sum
```

Variable	Obs	Mean	Std. Dev.	Min	Max
rns	758	.2691293	.4438001	0	1
rns80	758	.292876	.4553825	0	1
mrt	758	.5145119	.5001194	0	1
mrt80	758	.8984169	.3022988	0	1
smsa	758	.7044855	.456575	0	1
smsa80	758	.7124011	.452942	0	1
med	758	10.91029	2.74112	0	18
iq	758	103.8562	13.61867	54	145
kww	758	36.57388	7.302247	12	56
year	758	69.03166	2.631794	66	73
age	758	21.83509	2.981756	16	30
age80	758	33.01187	3.085504	28	38
s	758	13.40501	2.231828	9	18
s80	758	13.70712	2.214693	9	18
expr	758	1.735429	2.105542	0	11.444
expr80	758	11.39426	4.210745	.692	22.045
tenure	758	1.831135	1.67363	0	10
tenure80	758	7.362797	5.05024	0	22
lw	758	5.686739	.4289494	4.605	7.051
lw80	758	6.826555	.4099268	4.749	8.032

```
. pwcorr iq s,sig
```

	iq	s
iq	1.0000	
s	0.5131 0.0000	1.0000

```
. reg lw s expr tenure rns smsa,r
```

Linear regression	Number of obs	=	758
	F(5, 752)	=	84.05
	Prob > F	=	0.0000
	R-squared	=	0.3521
	Root MSE	=	.34641

	Robust
--	--------

lw	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
s	.102643	.0062099	16.53	0.000	.0904523	.1148338
expr	.0381189	.0066144	5.76	0.000	.025134	.0511038
tenure	.0356146	.0079988	4.45	0.000	.0199118	.0513173
rns	-.0840797	.029533	-2.85	0.005	-.1420566	-.0261029
smsa	.1396666	.028056	4.98	0.000	.0845893	.194744
_cons	4.103675	.0876665	46.81	0.000	3.931575	4.275775

```
. reg lw s iq expr tenure rns smsa,r
```

Linear regression

Number of obs = 758
F(6, 751) = 71.89
Prob > F = 0.0000
R-squared = 0.3600
Root MSE = .34454

lw	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
s	.0927874	.0069763	13.30	0.000	.0790921	.1064826
iq	.0032792	.0011321	2.90	0.004	.0010567	.0055016
expr	.0393443	.0066603	5.91	0.000	.0262692	.0524193
tenure	.034209	.0078957	4.33	0.000	.0187088	.0497092
rns	-.0745325	.0299772	-2.49	0.013	-.1333815	-.0156834
smsa	.1367369	.0277712	4.92	0.000	.0822186	.1912553
_cons	3.895172	.1159286	33.60	0.000	3.667589	4.122754

```
. ivregress 2sls lw s expr tenure rns smsa (iq=med kww mrt age),r
```

Instrumental variables (2SLS) regression

Number of obs = 758
Wald chi2(6) = 355.73
Prob > chi2 = 0.0000
R-squared = 0.2002
Root MSE = .38336

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	-.0115468	.0056376	-2.05	0.041	-.0225962	-.0004974
s	.1373477	.0174989	7.85	0.000	.1030506	.1716449
expr	.0338041	.0074844	4.52	0.000	.019135	.0484732
tenure	.040564	.0095848	4.23	0.000	.0217781	.05935
rns	-.1176984	.0359582	-3.27	0.001	-.1881751	-.0472216
smsa	.149983	.0322276	4.65	0.000	.0868182	.2131479
_cons	4.837875	.3799432	12.73	0.000	4.0932	5.58255

Instrumented: iq
Instruments: s expr tenure rns smsa med kww mrt age

test the first condition of valid instrumental variable

. estat overid

Test of overidentifying restrictions:

Score chi2(3) = 51.5449 (p = 0.0000)

ssc install ivreg2 ssc install ranktest

. ivreg2 lw s expr tenure rns smsa (iq = med kww mrt age),r orthog(mrt age)

IV (2SLS) estimation

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity

Total (centered) SS	=	139.2861498	Number of obs	=	758
Total (uncentered) SS	=	24652.24662	F(6, 751)	=	58.74
Residual SS	=	111.39959	Prob > F	=	0.0000
			Centered R2	=	0.2002
			Uncentered R2	=	0.9955
			Root MSE	=	.3834

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	-.0115468	.0056376	-2.05	0.041	-.0225962	-.0004974
s	.1373477	.0174989	7.85	0.000	.1030506	.1716449
expr	.0338041	.0074844	4.52	0.000	.019135	.0484732
tenure	.040564	.0095848	4.23	0.000	.0217781	.05935
rns	-.1176984	.0359582	-3.27	0.001	-.1881751	-.0472216
smsa	.149983	.0322276	4.65	0.000	.0868182	.2131479
_cons	4.837875	.3799432	12.73	0.000	4.0932	5.58255

Underidentification test (Kleibergen-Paap rk LM statistic): 33.294
Chi-sq(4) P-val = 0.0000

Weak identification test (Cragg-Donald Wald F statistic): 10.538
(Kleibergen-Paap rk Wald F statistic): 9.585

Stock-Yogo weak ID test critical values:

5% maximal IV relative bias	16.85
10% maximal IV relative bias	10.27
20% maximal IV relative bias	6.71
30% maximal IV relative bias	5.34
10% maximal IV size	24.58
15% maximal IV size	13.96
20% maximal IV size	10.26

25% maximal IV size 8.31

Source: Stock-Yogo (2005). Reproduced by permission.
 NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.

Hansen J statistic (overidentification test of all instruments): 51.545
Chi-sq(3) P-val = 0.0000

-orthog- option:

Hansen J statistic (eqn. excluding suspect orthog. conditions): 0.116
Chi-sq(1) P-val = 0.7333

C statistic (exogeneity/orthogonality of suspect instruments): 51.429
Chi-sq(2) P-val = 0.0000

Instruments tested: mrt age

Instrumented: iq
 Included instruments: s expr tenure rns smsa
 Excluded instruments: med kww mrt age

. ivregress 2sls lw s expr tenure rns smsa (iq = med kww) ,r first

First-stage regressions

Number of obs = 758
 F(7, 750) = 47.74
 Prob > F = 0.0000
 R-squared = 0.3066
 Adj R-squared = 0.3001
 Root MSE = 11.3931

iq	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
s	2.467021	.2327755	10.60	0.000	2.010052	2.92399
expr	-.4501353	.2391647	-1.88	0.060	-.9196471	.0193766
tenure	.2059531	.269562	0.76	0.445	-.3232327	.7351388
rns	-2.689831	.8921335	-3.02	0.003	-4.441207	-.938455
smsa	.2627416	.9465309	0.28	0.781	-1.595424	2.120907
med	.3470133	.1681356	2.06	0.039	.0169409	.6770857
kww	.3081811	.0646794	4.76	0.000	.1812068	.4351553
_cons	56.67122	3.076955	18.42	0.000	50.63075	62.71169

Instrumental variables (2SLS) regression

Number of obs = 758
 Wald chi2(6) = 370.04
 Prob > chi2 = 0.0000
 R-squared = 0.2775
 Root MSE = .36436

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	.0139284	.0060393	2.31	0.021	.0020916	.0257653
s	.0607803	.0189505	3.21	0.001	.023638	.0979227
expr	.0433237	.0074118	5.85	0.000	.0287968	.0578505
tenure	.0296442	.008317	3.56	0.000	.0133432	.0459452
rns	-.0435271	.0344779	-1.26	0.207	-.1111026	.0240483
smsa	.1272224	.0297414	4.28	0.000	.0689303	.1855146
_cons	3.218043	.3983683	8.08	0.000	2.437256	3.998831

Instrumented: iq

Instruments: s expr tenure rns smsa med kww

. estat overid

Test of overidentifying restrictions:

Score chi2(1) = .151451 (p = 0.6972)

test the second condition of valid instrumental variable

. estat firststage,all forcenonrobust

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(2,750)	Prob > F
iq	0.3066	0.3001	0.0382	13.4028	0.0000

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
iq	0.0382	0.0305

Minimum eigenvalue statistic = 14.9058

Critical Values # of endogenous regressors: 1
Ho: Instruments are weak # of excluded instruments: 2

	5%	10%	20%	30%
2SLS relative bias	(not available)			

	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	19.93	11.59	8.75	7.25
LIML Size of nominal 5% Wald test	8.68	5.33	4.42	3.92

```
. ivregress liml lw s expr tenure rns smsa (iq = med kww),r
```

Instrumental variables (LIML) regression	Number of obs	=	758
	Wald chi2(6)	=	369.62
	Prob > chi2	=	0.0000
	R-squared	=	0.2768
	Root MSE	=	.36454

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	.0139764	.0060681	2.30	0.021	.0020831	.0258697
s	.0606362	.019034	3.19	0.001	.0233303	.0979421
expr	.0433416	.0074185	5.84	0.000	.0288016	.0578816
tenure	.0296237	.008323	3.56	0.000	.0133109	.0459364
rns	-.0433875	.034529	-1.26	0.209	-.1110631	.0242881
smsa	.1271796	.0297599	4.27	0.000	.0688512	.185508
_cons	3.214994	.4001492	8.03	0.000	2.430716	3.999272

Instrumented: iq

Instruments: s expr tenure rns smsa med kww

```
. ivreg2 lw s expr tenure rns smsa (iq = med kww), r redundant(kww)
```

IV (2SLS) estimation

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity

	Number of obs	=	758
	F(6, 751)	=	61.10
	Prob > F	=	0.0000
Total (centered) SS	=	139.2861498	
Total (uncentered) SS	=	24652.24662	
Residual SS	=	100.6291971	
	Centered R2	=	0.2775
	Uncentered R2	=	0.9959
	Root MSE	=	.3644

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	.0139284	.0060393	2.31	0.021	.0020916	.0257653
s	.0607803	.0189505	3.21	0.001	.023638	.0979227
expr	.0433237	.0074118	5.85	0.000	.0287968	.0578505
tenure	.0296442	.008317	3.56	0.000	.0133432	.0459452
rns	-.0435271	.0344779	-1.26	0.207	-.1111026	.0240483

smsa	.1272224	.0297414	4.28	0.000	.0689303	.1855146
_cons	3.218043	.3983683	8.08	0.000	2.437256	3.998831

Underidentification test (Kleibergen-Paap rk LM statistic): 24.223
Chi-sq(2) P-val = 0.0000

-redundant- option:

IV redundancy test (LM test of redundancy of specified instruments): 22.222
Chi-sq(1) P-val = 0.0000

Instruments tested: kww

Weak identification test (Cragg-Donald Wald F statistic): 14.906
(Kleibergen-Paap rk Wald F statistic): 13.403

Stock-Yogo weak ID test critical values: 10% maximal IV size 19.93
15% maximal IV size 11.59
20% maximal IV size 8.75
25% maximal IV size 7.25

Source: Stock-Yogo (2005). Reproduced by permission.

NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.

Hansen J statistic (overidentification test of all instruments): 0.151
Chi-sq(1) P-val = 0.6972

Instrumented: iq
Included instruments: s expr tenure rns smsa
Excluded instruments: med kww

```
. qui reg lw iq s expr tenure rns smsa

. est store ols

. qui ivregress 2sls lw s expr tenure rns smsa (iq = med kww)

. est store iv

. hausman iv ols, constant sigmamore
```

Note: the rank of the differenced variance matrix (1) does not equal the number of coefficients being tested (7); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) iv	(B) ols		
iq	.0139284	.0032792	.0106493	.0054318
s	.0607803	.0927874	-.032007	.0163254
expr	.0433237	.0393443	.0039794	.0020297
tenure	.0296442	.034209	-.0045648	.0023283

rns	-.0435271	-.0745325	.0310054	.0158145
smsa	.1272224	.1367369	-.0095145	.0048529
_cons	3.218043	3.895172	-.6771285	.3453751

b = consistent under Ho and Ha; obtained from ivregress
B = inconsistent under Ha, efficient under Ho; obtained from regress

Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 3.84
Prob>chi2 = 0.0499
(V_b-V_B is not positive definite)

```
. qui reg lw iq s expr tenure rns smsa,r
. qui ivregress 2sls lw s expr tenure rns smsa (iq = med kww),r
. estat endogenous
```

Tests of endogeneity
Ho: variables are exogenous

Robust score chi2(1) = 3.56217 (p = 0.0591)
Robust regression F(1,750) = 3.65567 (p = 0.0563)

```
. ivreg2 lw s expr tenure rns smsa (iq=med kww),r endog(iq)
```

IV (2SLS) estimation

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity

Total (centered) SS	=	139.2861498	Number of obs	=	758
Total (uncentered) SS	=	24652.24662	F(6, 751)	=	61.10
Residual SS	=	100.6291971	Prob > F	=	0.0000
			Centered R2	=	0.2775
			Uncentered R2	=	0.9959
			Root MSE	=	.3644

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	.0139284	.0060393	2.31	0.021	.0020916	.0257653
s	.0607803	.0189505	3.21	0.001	.023638	.0979227
expr	.0433237	.0074118	5.85	0.000	.0287968	.0578505
tenure	.0296442	.008317	3.56	0.000	.0133432	.0459452
rns	-.0435271	.0344779	-1.26	0.207	-.1111026	.0240483
smsa	.1272224	.0297414	4.28	0.000	.0689303	.1855146

_cons	3.218043	.3983683	8.08	0.000	2.437256	3.998831
-------	----------	----------	------	-------	----------	----------

Underidentification test (Kleibergen-Paap rk LM statistic): 24.223
Chi-sq(2) P-val = 0.0000

Weak identification test (Cragg-Donald Wald F statistic): 14.906
(Kleibergen-Paap rk Wald F statistic): 13.403
Stock-Yogo weak ID test critical values: 10% maximal IV size 19.93
15% maximal IV size 11.59
20% maximal IV size 8.75
25% maximal IV size 7.25

Source: Stock-Yogo (2005). Reproduced by permission.

NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.

Hansen J statistic (overidentification test of all instruments): 0.151
Chi-sq(1) P-val = 0.6972

-endog- option:

Endogeneity test of endogenous regressors: 3.615
Chi-sq(1) P-val = 0.0573

Regressors tested: iq

Instrumented: iq

Included instruments: s expr tenure rns smsa

Excluded instruments: med kww

. ivregress gmm lw s expr tenure rns smsa (iq=med kww)

Instrumental variables (GMM) regression Number of obs = 758
Wald chi2(6) = 372.75
Prob > chi2 = 0.0000
R-squared = 0.2750
GMM weight matrix: Robust Root MSE = .36499

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	.0140888	.0060357	2.33	0.020	.0022591	.0259185
s	.0603672	.0189545	3.18	0.001	.0232171	.0975174
expr	.0431117	.0074112	5.82	0.000	.0285861	.0576373
tenure	.0299764	.0082728	3.62	0.000	.013762	.0461908
rns	-.044516	.0344404	-1.29	0.196	-.1120179	.0229859
smsa	.1267368	.0297633	4.26	0.000	.0684018	.1850718
_cons	3.207298	.398083	8.06	0.000	2.427069	3.987526

Instrumented: iq

Instruments: s expr tenure rns smsa med kww

. estat overid

Test of overidentifying restriction:

Hansen's J chi2(1) = .151451 (p = 0.6972)

```
. ivregress gmm lw s expr tenure rns smsa (iq = med kww),igmm
Iteration 1: change in beta = 1.753e-05   change in W = 1.100e-02
Iteration 2: change in beta = 4.872e-08   change in W = 7.880e-05
Iteration 3: change in beta = 2.501e-10   change in W = 2.304e-07
```

Instrumental variables (GMM) regression	Number of obs	=	758
	Wald chi2(6)	=	372.73
	Prob > chi2	=	0.0000
	R-squared	=	0.2750
GMM weight matrix: Robust	Root MSE	=	.36499

lw	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
iq	.0140901	.0060357	2.33	0.020	.0022603	.02592
s	.0603629	.0189548	3.18	0.001	.0232122	.0975135
expr	.0431101	.0074113	5.82	0.000	.0285841	.057636
tenure	.0299752	.0082729	3.62	0.000	.0137606	.0461898
rns	-.0445114	.0344408	-1.29	0.196	-.1120142	.0229913
smsa	.1267399	.0297637	4.26	0.000	.0684041	.1850757
_cons	3.207224	.3980878	8.06	0.000	2.426986	3.987462

```
Instrumented: iq
Instruments: s expr tenure rns smsa med kww
```

```
. qui reg lw s expr tenure rns smsa,r

. est store ols_no_iq

. qui reg lw iq s expr tenure rns smsa,r

. est store ols_with_iq

. qui ivregress 2sls lw s expr tenure rns smsa (iq= med kww),r

. est store tsls

. qui ivregress liml lw s expr tenure rns smsa (iq= med kww),r

. est store liml

. qui ivregress gmm lw s expr tenure rns smsa (iq= med kww)

. est store gmm

. qui ivregress gmm lw s expr tenure rns smsa (iq= med kww),igmm
```

```
. est store igmm
. esttab ols_no_iq ols_with_iq tsls liml gmm igmm,se r2 mtitle
```

	(1) (5) gmm	(2) (6) ols_no_iq igmm	(3) (1) ols_with_iq	(4) (2) tsls	(5) (3) liml
s	0.103*** 0.0604** (0.0190)	0.0604** (0.00621) (0.0190)	0.0928*** (0.00698)	0.0608** (0.0190)	0.0606** (0.0190)
expr	0.0381*** 0.0431*** (0.00741)	0.0431*** (0.00661) (0.00741)	0.0393*** (0.00666)	0.0433*** (0.00741)	0.0433*** (0.00742)
tenure	0.0356*** 0.0300*** (0.00827)	0.0300*** (0.00800) (0.00827)	0.0342*** (0.00790)	0.0296*** (0.00832)	0.0296*** (0.00832)
rns	-0.0841** -0.0445 (0.0344)	-0.0445 (0.0295) (0.0344)	-0.0745* (0.0300)	-0.0435 (0.0345)	-0.0434 (0.0345)
smsa	0.140*** 0.127*** (0.0298)	0.127*** (0.0281) (0.0298)	0.137*** (0.0278)	0.127*** (0.0297)	0.127*** (0.0298)
iq	0.0141* (0.00604)	0.0141* (0.00604)	0.00328** (0.00113)	0.0139* (0.00604)	0.0140* (0.00607)
_cons	4.104*** 3.207*** (0.398)	3.207*** (0.0877) (0.398)	3.895*** (0.116)	3.218*** (0.398)	3.215*** (0.400)
N	758	758	758	758	758

R-sq	0.352	0.360	0.278	0.277
0.275	0.275			

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$