

Trabajo Práctico N° 3: **Modelos de Paneles Dinámicos.**

Ejercicio 1.

Considerar la base de datos “mod_abdata.dta” que fue utilizada por Arellano y Bond en su famoso paper de 1991. Se trata de un panel de 140 empresas británicas encuestadas, anualmente, entre 1976 y 1984. El panel original no es balanceado, pero la versión para este ejercicio se trata de un panel balanceado de empresas con observaciones para, exactamente, 6 años entre 1977 y 1982. La variable que identifica la empresa es *id* y la variable que identifica el tiempo es *year*. La variable *n* es el empleo de la empresa. Luego, considerar un modelo muy simplificado del siguiente tipo:

$$\ln n_{it} = \rho \ln n_{it-1} + \varepsilon_{it},$$

$$\varepsilon_{it} = c_i + v_{it},$$

$$E(c_i) = E(v_{it}) = E(c_i v_{it}) = 0,$$

donde n_{it} es el empleo de la empresa *i* en el año *t*.

(a) Estimar el modelo por OLS. ¿Qué sesgo se esperaría encontrar y por qué?

POLS:

Source	SS	df	MS	Number of obs	=	770
Model	1396.09073	1	1396.09073	F(1, 768)	=	76542.09
Residual	14.0079495	768	.018239518	Prob > F	=	0.0000
Total	1410.09868	769	1.83367839	R-squared	=	0.9901
				Adj R-squared	=	0.9901
				Root MSE	=	.13505

n	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
nL1	.9967362	.0036027	276.66	0.000	.9896639	1.003809
_cons	-.0379493	.0063799	-5.95	0.000	-.0504734	-.0254252

El sesgo que se esperaría encontrar es el sesgo de paneles dinámicos, el cual se desprende que $\ln n_{it-1}$ está correlacionado con los efectos fijos, c_i , que se encuentran en el término de error. En general, bajo muchos supuestos, OLS sobrestima el valor real del parámetro ρ .

(b) Estimar el modelo usando efectos fijos (FE). ¿Permite la transformación within eliminar el sesgo de paneles dinámicos?

FE:

```
Fixed-effects (within) regression      Number of obs   =       770
Group variable: id                    Number of groups =       138

R-squared:                             Obs per group:
    Within = 0.4926                      min =          5
    Between = 0.9979                     avg =         5.6
    Overall = 0.9901                     max =          6

corr(u_i, Xb) = 0.9382                  F(1,631)         =      612.49
                                         Prob > F          =      0.0000
```

```
-----+-----
            n | Coefficient   Std. err.      t    P>|t|    [95% conf. interval]
-----+-----
      nL1 |      .869605   .0351375    24.75   0.000   .8006043   .9386056
      _cons |     .1076112   .0405095     2.66   0.008   .0280614   .1871609
-----+-----
      sigma_u |     .18358137
      sigma_e |     .1315487
      rho |     .66073284   (fraction of variance due to u_i)
-----+-----
F test that all u_i=0: F(137, 631) = 1.30                Prob > F = 0.0194
```

La transformación *within* no permite eliminar el sesgo de paneles dinámicos, ya que, ahora, el problema se encuentra en que $\ln \widetilde{n_{it-1}} = \ln n_{it-1} - \overline{\ln n_{i-1}}$ está correlacionado con $\widetilde{v_{it}} = v_{it} - \bar{v}_i$, aun cuando v_{it} no tiene correlación serial. En particular, el término $\ln n_{it-1}$ correlaciona negativamente con $\frac{-1}{T-1} v_{it-1}$ que se encuentra dentro de \bar{v}_i , mientras que, simétricamente, $\frac{-1}{T-1} \ln n_{it}$ y v_{it} también se encuentran correlacionados negativamente. Adicionalmente, hay otros pares de términos que correlacionan, pero su impacto es de segundo orden. Por último, cabe mencionar que Nickell mostró que, si $\rho > 0$, este sesgo es siempre negativo.

(c) Considerar una transformación de diferencias finitas de primer orden del modelo. ¿Continúa siendo la variable dependiente rezagada potencialmente endógena?

Considerando una transformación de diferencias finitas de primer orden del modelo, la variable dependiente rezagada continúa siendo potencialmente endógena, ya que el término $\Delta \ln n_{it-1} = \ln n_{it-1} - \ln n_{it-2}$ está correlacionado con v_{it-1} en $\Delta v_{it} = v_{it} - v_{it-1}$.

(d) Implementar el estimador de Anderson-Hsiao a partir del comando `ivregress` en Stata.

IV (Anderson-Hsiao):

```
Instrumental variables 2SLS regression      Number of obs   =      632
                                           Wald chi2(1)    =      .
                                           Prob > chi2     =      .
                                           R-squared      =      .
                                           Root MSE      =      .25024
```

```
-----+-----
      D.n | Coefficient  Std. err.      z    P>|z|    [95% conf. interval]
-----+-----
      nL1 |
      D1. |    2.015601   .4911953    4.10   0.000    1.052876    2.978327
-----+-----
```

```
Instrumented: D.nL1
Instruments: nL2
```

(e) Ahora, obtener la estimación GMM de ρ utilizando todos los instrumentos posibles en niveles para el modelo en primeras diferencias. Para ello, utilizar el comando `xtabond2`.

GMM One-Step (Arellano-Bond):

Dynamic panel-data estimation, one-step difference GMM

```
-----+-----
Group variable: id                      Number of obs   =      632
Time variable : year                   Number of groups =      138
Number of instruments = 10              Obs per group: min =      4
Wald chi2(0) = .                        avg =      4.58
Prob > chi2 = .                        max =      5
-----+-----
```

```
-----+-----
      n | Coefficient  Std. err.      z    P>|z|    [95% conf. interval]
-----+-----
      nL1 |    1.146045   .0865907   13.24   0.000    .9763309    1.31576
-----+-----
```

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

```
-----+-----
Arellano-Bond test for AR(1) in first differences: z = -4.21 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -2.35 Pr > z = 0.019
-----+-----
```

```
Sargan test of overid. restrictions: chi2(9) = 122.88 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)
```

GMM Two-Step (Arellano-Bond):

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                Number of obs   =      632
Time variable : year              Number of groups =      138
Number of instruments = 10         Obs per group: min =       4
Wald chi2(0)   =                  .               avg   =      4.58
Prob > chi2    =                  .               max   =       5
-----
```

```
-----
              n | Coefficient  Std. err.      z    P>|z|    [95% conf. interval]
-----+-----
              nL1 |   1.176208   .0771686    15.24   0.000    1.024961    1.327456
-----
```

Warning: Uncorrected two-step standard errors are unreliable.

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z =  -2.97   Pr > z =  0.003
Arellano-Bond test for AR(2) in first differences: z =  -1.71   Pr > z =  0.087
-----
```

```
Sargan test of overid. restrictions: chi2(9)    = 122.88   Prob > chi2 =  0.000
(Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(9)    =  48.86   Prob > chi2 =  0.000
(Robust, but weakened by many instruments.)
```

(f) *Obtener la estimación de GMM de ρ utilizando todos los instrumentos posibles en niveles para el modelo en primeras diferencias e Δy_{it-1} como instrumento para el modelo en niveles.*

SGMM One-Step (Blundell-Bond):

Dynamic panel-data estimation, one-step system GMM

Group variable: id	Number of obs	=	770
Time variable : year	Number of groups	=	138
Number of instruments = 15	Obs per group: min	=	5
Wald chi2(1) = 75831.06	avg	=	5.58
Prob > chi2 = 0.000	max	=	6

	n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]
nL1	|	1.107192	.0200965	55.09	0.000	1.067803 1.14658
_cons	|	-.1644167	.0233703	-7.04	0.000	-.2102216 -.1186118

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

Instruments for levels equation

Standard
_cons
GMM-type (missing=0, separate instruments for each period unless collapsed)
D.L.n

Arellano-Bond test for AR(1) in first differences: z = -5.47 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -2.27 Pr > z = 0.023

Sargan test of overid. restrictions: chi2(13) = 168.40 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)

Difference-in-Sargan tests of exogeneity of instrument subsets:

GMM instruments for levels
Sargan test excluding group: chi2(9) = 127.56 Prob > chi2 = 0.000
Difference (null H = exogenous): chi2(4) = 40.84 Prob > chi2 = 0.000

SGMM Two-Step (Blundell-Bond):

Dynamic panel-data estimation, two-step system GMM

```
-----
Group variable: id                      Number of obs   =      770
Time variable : year                   Number of groups =     138
Number of instruments = 15              Obs per group: min =      5
Wald chi2(1)   = 23169.14                avg =     5.58
Prob > chi2    =      0.000                max =      6
-----
```

	n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]
nL1	|	1.149856	.0316392	36.34	0.000	1.087845 1.211868
_cons	|	-.1738829	.0370401	-4.69	0.000	-.2464801 -.1012857

Warning: Uncorrected two-step standard errors are unreliable.

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

Instruments for levels equation

Standard

_cons

GMM-type (missing=0, separate instruments for each period unless collapsed)
D.L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z = -3.18 Pr > z = 0.001
Arellano-Bond test for AR(2) in first differences: z = -1.71 Pr > z = 0.087
-----
```

Sargan test of overid. restrictions: chi2(13) = 168.40 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(13) = 56.19 Prob > chi2 = 0.000
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:

GMM instruments for levels

Hansen test excluding group: chi2(9) = 49.15 Prob > chi2 = 0.000

Difference (null H = exogenous): chi2(4) = 7.04 Prob > chi2 = 0.134

(g) Repetir las estimaciones de los incisos (e) y (f) incluyendo efectos fijos de tiempo.

GMM One-Step (Arellano-Bond):

Dynamic panel-data estimation, one-step difference GMM

```
-----
Group variable: id                Number of obs   =      632
Time variable : year             Number of groups =      138
Number of instruments = 15        Obs per group: min =       4
Wald chi2(0)   =                  avg   =      4.58
Prob > chi2    =                  max   =       5
-----
```

	n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]
nL1	|	.2667934	.1114731	2.39	0.017	.0483102 .4852767
yr1977	|	.0072053	.0133804	0.54	0.590	-.0190198 .0334304
yr1978	|	-.000092	.0101049	-0.01	0.993	-.0198972 .0197132
yr1980	|	-.0390927	.010015	-3.90	0.000	-.0587218 -.0194636
yr1981	|	-.1440582	.0107307	-13.42	0.000	-.1650901 -.1230264
yr1982	|	-.214458	.0194763	-11.01	0.000	-.2526308 -.1762851

Instruments for first differences equation

Standard

D.(yr1977 yr1978 yr1979 yr1980 yr1981 yr1982)

GMM-type (missing=0, separate instruments for each period unless collapsed)

L(1/5).L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z =   0.30   Pr > z =   0.764
Arellano-Bond test for AR(2) in first differences: z =  -0.93   Pr > z =   0.351
-----
```

```
Sargan test of overid. restrictions: chi2(9)   =  36.01   Prob > chi2 =   0.000
(Not robust, but not weakened by many instruments.)
```

GMM Two-Step (Arellano-Bond):

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                Number of obs   =      632
Time variable : year             Number of groups =      138
Number of instruments = 15        Obs per group: min =       4
Wald chi2(0)   =                  avg   =      4.58
Prob > chi2    =                  max   =       5
-----
```

	n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]
nL1	|	.4092502	.0923988	4.43	0.000	.2281518 .5903486
yr1977	|	.0090912	.0095385	0.95	0.341	-.009604 .0277864
yr1978	|	.0020047	.0051366	0.39	0.696	-.0080629 .0120723
yr1980	|	-.0313017	.0073163	-4.28	0.000	-.0456414 -.0169621
yr1981	|	-.1342723	.0163176	-8.23	0.000	-.1662543 -.1022903
yr1982	|	-.2001323	.0235447	-8.50	0.000	-.2462791 -.1539855

Warning: Uncorrected two-step standard errors are unreliable.

Instruments for first differences equation

Standard

D.(yr1977 yr1978 yr1979 yr1980 yr1981 yr1982)

GMM-type (missing=0, separate instruments for each period unless collapsed)

L(1/5).L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z =  -0.90   Pr > z =   0.370
Arellano-Bond test for AR(2) in first differences: z =  -1.22   Pr > z =   0.222
-----
```

```
Sargan test of overid. restrictions: chi2(9)   =  36.01   Prob > chi2 =   0.000
(Not robust, but not weakened by many instruments.)
```

```
Hansen test of overid. restrictions: chi2(9)   =  11.00   Prob > chi2 =   0.276
(Robust, but weakened by many instruments.)
```

SGMM One-Step (Blundell-Bond):

Dynamic panel-data estimation, one-step system GMM

```
-----
Group variable: id                      Number of obs   =      770
Time variable : year                    Number of groups =     138
Number of instruments = 20              Obs per group: min =      5
Wald chi2(6) = 84467.08                  avg =      5.58
Prob > chi2 = 0.000                      max =      6
-----
```

	n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]	
nL1	|	1.070702	.0198077	54.05	0.000	1.031879	1.109524
yr1977	|	.0438478	.0151864	2.89	0.004	.0140831	.0736126
yr1978	|	.0518471	.0129701	4.00	0.000	.0264261	.0772681
yr1979	|	.0418566	.0129664	3.23	0.001	.0164428	.0672704
yr1981	|	-.0742759	.0129883	-5.72	0.000	-.0997325	-.0488193
yr1982	|	-.0521052	.0133172	-3.91	0.000	-.0782065	-.026004
_cons	|	-.1213363	.0250374	-4.85	0.000	-.1704086	-.072264

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

Instruments for levels equation

Standard
yr1977 yr1978 yr1979 yr1980 yr1981 yr1982
_cons

GMM-type (missing=0, separate instruments for each period unless collapsed)
D.L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z = -6.30 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -2.36 Pr > z = 0.018
-----
```

Sargan test of overid. restrictions: chi2(13) = 79.17 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)

Difference-in-Sargan tests of exogeneity of instrument subsets:

GMM instruments for levels

Sargan test excluding group: chi2(9) = 21.45 Prob > chi2 = 0.011
Difference (null H = exogenous): chi2(4) = 57.72 Prob > chi2 = 0.000

iv(yr1977 yr1978 yr1979 yr1980 yr1981 yr1982, eq(level))

Sargan test excluding group: chi2(8) = 56.13 Prob > chi2 = 0.000
Difference (null H = exogenous): chi2(5) = 23.05 Prob > chi2 = 0.000

SGMM Two-Step (Blundell-Bond):

Dynamic panel-data estimation, two-step system GMM

```
-----
Group variable: id                      Number of obs   =      770
Time variable : year                    Number of groups =     138
Number of instruments = 20              Obs per group: min =      5
Wald chi2(6)  = 19554.89                  avg =     5.58
Prob > chi2    =      0.000                  max =      6
-----
```

	n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]
nL1	|	1.115279	.0252032	44.25	0.000	1.065881 1.164676
yr1977	|	.042046	.0187107	2.25	0.025	.0053737 .0787184
yr1978	|	.0475315	.0087333	5.44	0.000	.0304146 .0646484
yr1979	|	.0347642	.0075048	4.63	0.000	.0200551 .0494734
yr1981	|	-.0766901	.0109072	-7.03	0.000	-.0980679 -.0553123
yr1982	|	-.0535137	.0128686	-4.16	0.000	-.0787358 -.0282917
_cons	|	-.1778026	.0308186	-5.77	0.000	-.238206 -.1173993

Warning: Uncorrected two-step standard errors are unreliable.

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

Instruments for levels equation

Standard
yr1977 yr1978 yr1979 yr1980 yr1981 yr1982
_cons

GMM-type (missing=0, separate instruments for each period unless collapsed)
D.L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z = -3.22 Pr > z = 0.001
Arellano-Bond test for AR(2) in first differences: z = -1.56 Pr > z = 0.118
-----
```

Sargan test of overid. restrictions: chi2(13) = 79.17 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(13) = 28.91 Prob > chi2 = 0.007
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:

GMM instruments for levels

Hansen test excluding group: chi2(9) = 6.67 Prob > chi2 = 0.671
Difference (null H = exogenous): chi2(4) = 22.23 Prob > chi2 = 0.000

iv(yr1977 yr1978 yr1979 yr1980 yr1981 yr1982, eq(level))

Hansen test excluding group: chi2(8) = 22.21 Prob > chi2 = 0.005
Difference (null H = exogenous): chi2(5) = 6.69 Prob > chi2 = 0.244

Ejercicio 2.

En este ejercicio, se ilustrará el hecho de que los estimadores de Arellano-Bond y de Blundell-Bond pueden extenderse, en forma directa, a modelos que incluyan regresores estrictamente exógenos y regresores secuencialmente exógenos.

En su paper original, Arellano y Bond modelaron el empleo de las empresas (n) utilizando un modelo de ajuste parcial para reflejar los costos de contratación y despido, incluyendo dos rezagos de la variable empleo. Otras variables incluidas fueron el nivel salarial actual y el rezagado (w), el stock de capital actual, rezagado una y dos veces (k), y la producción agregada actual, rezagada una y dos veces en el sector de la empresa (ys). Todas las variables se expresan en logaritmos. También se incluye un conjunto de variables dummy de tiempo.

(a) Estimar el modelo por OLS. Computar los errores estándar robustos a heterocedasticidad y correlación serial.

POLS:

```
Linear regression                                Number of obs   =          632
                                                F(14, 137)      =       15042.46
                                                Prob > F        =         0.0000
                                                R-squared       =         0.9948
                                                Root MSE      =         .09885
```

(Std. err. adjusted for 138 clusters in id)

	n	Coefficient	Robust std. err.	t	P>|t|	[95% conf. interval]	
nL1	|	1.083681	.0479746	22.59	0.000	.9888145	1.178548
nL2	|	-.1204015	.0432502	-2.78	0.006	-.2059257	-.0348772
w	|	-.4314672	.1861579	-2.32	0.022	-.7995817	-.0633527
wL1	|	.3933175	.1806983	2.18	0.031	.035999	.7506359
k	|	.3214569	.0546692	5.88	0.000	.2133524	.4295614
kL1	|	-.2087172	.0674584	-3.09	0.002	-.3421117	-.0753228
kL2	|	-.0811552	.030786	-2.64	0.009	-.1420324	-.020278
ys	|	.5156912	.1862924	2.77	0.006	.1473108	.8840716
ysL1	|	-.7065917	.2745098	-2.57	0.011	-1.249416	-.1637674
ysL2	|	.2489473	.1450994	1.72	0.088	-.0379767	.5358714
yr1977	|	0	(omitted)				
yr1978	|	0	(omitted)				
yr1979	|	.0161153	.0087992	1.83	0.069	-.0012845	.0335151
yr1980	|	.0267825	.0153105	1.75	0.082	-.003493	.057058
yr1981	|	-.0111743	.0255106	-0.44	0.662	-.0616197	.0392712
yr1982	|	-.0017447	.0217911	-0.08	0.936	-.044835	.0413456
_cons	|	-.1238146	.2952534	-0.42	0.676	-.7076579	.4600287

(b) Estimar el modelo por FE. Computar los errores estándar robustos a heterocedasticidad y correlación serial.

FE:

```
Fixed-effects (within) regression      Number of obs   =      632
Group variable: id                    Number of groups =      138

R-squared:                             Obs per group:
    Within = 0.7708                      min =      4
    Between = 0.9706                     avg =     4.6
    Overall = 0.9674                     max =      5

corr(u_i, Xb) = 0.6273                  F(14,137)       =    128.03
                                         Prob > F        =     0.0000
```

(Std. err. adjusted for 138 clusters in id)

	n	Coefficient	Robust std. err.	t	P>|t|	[95% conf. interval]	
nL1	|	.712259	.0546499	13.03	0.000	.6041925	.8203255
nL2	|	-.2216269	.0557228	-3.98	0.000	-.3318149	-.1114389
w	|	-.504334	.1902322	-2.65	0.009	-.8805051	-.1281629
wL1	|	.1750077	.1374862	1.27	0.205	-.0968619	.4468772
k	|	.3667223	.0660277	5.55	0.000	.2361571	.4972875
kL1	|	-.0648159	.052492	-1.23	0.219	-.1686152	.0389834
kL2	|	.0287852	.0412597	0.70	0.487	-.0528031	.1103735
ys	|	.5252203	.1803162	2.91	0.004	.1686574	.8817831
ysL1	|	-.5622163	.2111979	-2.66	0.009	-.9798456	-.1445871
ysL2	|	.1339081	.1695363	0.79	0.431	-.2013383	.4691544
yr1977	|	0	(omitted)				
yr1978	|	.0218097	.0273806	0.80	0.427	-.0323336	.0759531
yr1979	|	.0241949	.0257897	0.94	0.350	-.0268024	.0751922
yr1980	|	.0319888	.0201233	1.59	0.114	-.0078037	.0717813
yr1981	|	-.0005961	.0168409	-0.04	0.972	-.0338978	.0327056
yr1982	|	0	(omitted)				
_cons	|	1.248446	.8176095	1.53	0.129	-.3683202	2.865213
sigma_u	|	.29806935					
sigma_e	|	.09040774					
rho	|	.91575291	(fraction of variance due to u_i)				

(c) Implementar el estimador de Anderson-Hsiao usando n_{it-2} como instrumento.

IV (Anderson-Hsiao):

Instrumental variables 2SLS regression	Number of obs	=	494
	Wald chi2(13)	=	14.10
	Prob > chi2	=	0.3669
	R-squared	=	.
	Root MSE	=	.53695

D.n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]	
nL1						
D1.	5.823993	14.07042	0.41	0.679	-21.75353	33.40152
nL2						
D1.	-.9846567	2.216574	-0.44	0.657	-5.329062	3.359749
w						
D1.	-.3323156	.4888956	-0.68	0.497	-1.290533	.6259022
wL1						
D1.	1.433551	3.563217	0.40	0.687	-5.550226	8.417328
k						
D1.	.0698672	.7653782	0.09	0.927	-1.430246	1.569981
kL1						
D1.	-1.708326	4.482217	-0.38	0.703	-10.49331	7.076659
kL2						
D1.	-.5052786	1.434586	-0.35	0.725	-3.317016	2.306459
ys						
D1.	1.344045	1.935232	0.69	0.487	-2.448939	5.13703
ysL1						
D1.	-2.722142	6.196766	-0.44	0.660	-14.86758	9.423296
ysL2						
D1.	-.1505585	.837905	-0.18	0.857	-1.792822	1.491705
yr1977						
D1.	0	(omitted)				
yr1978						
D1.	.0677291	.381059	0.18	0.859	-.6791328	.814591
yr1979						
D1.	.1150868	.3885855	0.30	0.767	-.6465268	.8767003
yr1980						
D1.	.1093503	.2766837	0.40	0.693	-.4329398	.6516404
yr1981						
D1.	0	(omitted)				
yr1982						
D1.	0	(omitted)				
_cons	.1190119	.350733	0.34	0.734	-.5684122	.806436

Instrumented: D.nL1

Instruments: D.nL2 D.w D.wL1 D.k D.kL1 D.kL2 D.ys D.ysL1 D.ysL2 D.yr1978
D.yr1979 D.yr1980 nL2

(d) Estimar la ecuación de empleo usando el estimador de Arellano-Bond. Asumir que la única endogeneidad presente es en el rezago de la variable dependiente.

GMM One-Step (Arellano-Bond):

Dynamic panel-data estimation, one-step difference GMM

```
-----
Group variable: id                      Number of obs   =      414
Time variable : year                   Number of groups =      138
Number of instruments = 20              Obs per group: min =       3
Wald chi2(0)   =                      .                avg   =      3.00
Prob > chi2    =                      .                max   =       3
-----
```

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

n							
L1.	|	.5325962	.4060438	1.31	0.190	-.2632351	1.328428
L2.	|	-.1678165	.108895	-1.54	0.123	-.3812468	.0456137
w							
--.	|	-.5435347	.1878885	-2.89	0.004	-.9117894	-.1752799
L1.	|	.0465042	.2149028	0.22	0.829	-.3746976	.467706
k							
--.	|	.3597198	.0798932	4.50	0.000	.203132	.5163076
L1.	|	-.0203542	.1486021	-0.14	0.891	-.311609	.2709006
L2.	|	.0531949	.0564035	0.94	0.346	-.0573539	.1637438
ys							
--.	|	.6720783	.1618321	4.15	0.000	.3548932	.9892634
L1.	|	-.3962257	.2155005	-1.84	0.066	-.818599	.0261475
L2.	|	-.061621	.1883471	-0.33	0.744	-.4307746	.3075325
yr1979	|	-.0019098	.0289454	-0.07	0.947	-.0586417	.0548221
yr1980	|	.0153498	.0194	0.79	0.429	-.0226734	.0533731
yr1982	|	-.0047222	.0199879	-0.24	0.813	-.0438977	.0344534

Instruments for first differences equation

Standard

D.(w L.w k L.k L2.k ys L.ys L2.ys yr1977 yr1978 yr1979 yr1980 yr1981 yr1982)

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z = -0.93 Pr > z = 0.351
Arellano-Bond test for AR(2) in first differences: z = -1.57 Pr > z = 0.117
-----
```

Sargan test of overid. restrictions: chi2(7) = 18.99 Prob > chi2 = 0.008
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(7) = 12.33 Prob > chi2 = 0.090
(Robust, but weakened by many instruments.)

GMM Two-Step (Arellano-Bond):

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                      Number of obs   =    414
Time variable : year                   Number of groups =    138
Number of instruments = 20              Obs per group: min =     3
Wald chi2(0)   =                      avg   =    3.00
Prob > chi2    =                      max   =     3
-----
```

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

	n						
	L1.	.6080291	.6739661	0.90	0.367	-.7129203	1.928978
	L2.	-.137942	.1688863	-0.82	0.414	-.468953	.1930691
	w						
	--.	-.4912924	.2335444	-2.10	0.035	-.949031	-.0335539
	L1.	.1263267	.2293468	0.55	0.582	-.3231847	.5758381
	k						
	--.	.2912765	.0889614	3.27	0.001	.1169154	.4656376
	L1.	-.0170639	.219071	-0.08	0.938	-.4464351	.4123073
	L2.	.0263268	.0736175	0.36	0.721	-.1179608	.1706145
	ys						
	--.	.5452599	.1895989	2.88	0.004	.1736528	.916867
	L1.	-.307353	.2411337	-1.27	0.202	-.7799662	.1652603
	L2.	-.1253987	.2036039	-0.62	0.538	-.524455	.2736577
	yr1979	.008789	.0360821	0.24	0.808	-.0619306	.0795087
	yr1980	.0244669	.0224526	1.09	0.276	-.0195394	.0684731
	yr1982	-.0189478	.0283143	-0.67	0.503	-.0744428	.0365472

Instruments for first differences equation

Standard

D.(w L.w k L.k L2.k ys L.ys L2.ys yr1977 yr1978 yr1979 yr1980 yr1981
yr1982)

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).L.n

```
-----
Arellano-Bond test for AR(1) in first differences: z =  -0.64  Pr > z =  0.523
Arellano-Bond test for AR(2) in first differences: z =  -1.41  Pr > z =  0.159
-----
```

Sargan test of overid. restrictions: chi2(7) = 18.99 Prob > chi2 = 0.008
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(7) = 12.33 Prob > chi2 = 0.090
(Robust, but weakened by many instruments.)

(e) Ahora, considerar, como hicieron Blundell y Bond (1998), que los salarios y el stock de capital no deben tomarse como estrictamente exógenos en este contexto (como se hizo en los modelos anteriores). Reestimar el modelo usando el estimador de A-B y considerando a los salarios y al stock de capital como regresores secuencialmente exógenos.

GMM One-Step (Arellano-Bond):

Dynamic panel-data estimation, one-step difference GMM

```
-----
Group variable: id                      Number of obs   =      414
Time variable : year                    Number of groups =      138
Number of instruments = 33              Obs per group: min =       3
Wald chi2(0)   =                      .                avg   =     3.00
Prob > chi2    =                      .                max   =       3
-----
```

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

	n						
	L1.	.8328315	.1219725	6.83	0.000	.5937698	1.071893
	L2.	-.1640736	.0770492	-2.13	0.033	-.3150873	-.0130599
	w						
	--.	-.5056556	.3148758	-1.61	0.108	-1.122801	.1114896
	L1.	.2750362	.3347117	0.82	0.411	-.3809867	.931059
	k						
	--.	.3384097	.1810356	1.87	0.062	-.0164135	.6932329
	L1.	-.2157422	.1197218	-1.80	0.072	-.4503925	.0189082
	L2.	-.0006972	.0481602	-0.01	0.988	-.0950895	.0936951
	ys						
	--.	.7245478	.2528721	2.87	0.004	.2289276	1.220168
	L1.	-.5540143	.4752081	-1.17	0.244	-1.485405	.3773765
	L2.	.0545983	.2887007	0.19	0.850	-.5112447	.6204413
	yr1979	-.0061002	.0303218	-0.20	0.841	-.0655299	.0533295
	yr1980	.0188299	.0214161	0.88	0.379	-.0231449	.0608046
	yr1982	-.0067336	.0217373	-0.31	0.757	-.049338	.0358708

Instruments for first differences equation

Standard

D.(ys L.ys L2.ys yr1977 yr1978 yr1979 yr1980 yr1981 yr1982)

GMM-type (missing=0, separate instruments for each period unless collapsed)

L(1/5).(L.n L.w L.k)

```
-----
Arellano-Bond test for AR(1) in first differences: z =  -3.83  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -2.12  Pr > z =  0.034
-----
```

Sargan test of overid. restrictions: chi2(20) = 38.36 Prob > chi2 = 0.008
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(20) = 22.98 Prob > chi2 = 0.290
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:

iv(ys L.ys L2.ys yr1977 yr1978 yr1979 yr1980 yr1981 yr1982)

Hansen test excluding group: chi2(14) = 14.84 Prob > chi2 = 0.389

Difference (null H = exogenous): chi2(6) = 8.14 Prob > chi2 = 0.228

GMM Two-Step (Arellano-Bond):

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                      Number of obs   =    414
Time variable : year                    Number of groups =    138
Number of instruments = 33              Obs per group: min =     3
Wald chi2(0)   =                      .                avg   =    3.00
Prob > chi2    =                      .                max   =     3
-----
```

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

	n						
	L1.	.9403457	.1894156	4.96	0.000	.5690979	1.311593
	L2.	-.1526986	.0928117	-1.65	0.100	-.3346062	.029209
	w						
	--.	-.4490707	.3993756	-1.12	0.261	-1.231833	.3336911
	L1.	.3385343	.3136958	1.08	0.281	-.2762982	.9533668
	k						
	--.	.1701686	.2126183	0.80	0.424	-.2465556	.5868928
	L1.	-.2258957	.1315513	-1.72	0.086	-.4837316	.0319401
	L2.	-.0419358	.0564683	-0.74	0.458	-.1526117	.0687401
	ys						
	--.	.689388	.2434718	2.83	0.005	.2121921	1.166584
	L1.	-.5276126	.4812107	-1.10	0.273	-1.470768	.4155429
	L2.	.1320996	.2419835	0.55	0.585	-.3421794	.6063786
	yr1979	.0193174	.0342941	0.56	0.573	-.0478977	.0865326
	yr1980	.0379698	.0228282	1.66	0.096	-.0067727	.0827124
	yr1982	-.0206929	.0242533	-0.85	0.394	-.0682285	.0268427

Instruments for first differences equation

Standard

D.(ys L.ys L2.ys yr1977 yr1978 yr1979 yr1980 yr1981 yr1982)

GMM-type (missing=0, separate instruments for each period unless collapsed)

L(1/5).(L.n L.w L.k)

```
-----
Arellano-Bond test for AR(1) in first differences: z = -2.47 Pr > z = 0.014
Arellano-Bond test for AR(2) in first differences: z = -1.74 Pr > z = 0.081
-----
```

Sargan test of overid. restrictions: chi2(20) = 38.36 Prob > chi2 = 0.008
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(20) = 22.98 Prob > chi2 = 0.290
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:

iv(ys L.ys L2.ys yr1977 yr1978 yr1979 yr1980 yr1981 yr1982)

Hansen test excluding group: chi2(14) = 14.84 Prob > chi2 = 0.389

Difference (null H = exogenous): chi2(6) = 8.14 Prob > chi2 = 0.228

(f) Adicionalmente, Blundell y Bond (1998) eliminan de su modelo los rezagos más largos (de dos períodos) del empleo y el capital y prescinden del nivel de producto agregado sectorial. Considerando esta cuestión, computar el estimador de Blundell-Bond.

SGMM One-Step (Blundell-Bond):

Dynamic panel-data estimation, one-step system GMM

```
-----
Group variable: id                      Number of obs   =      690
Time variable : year                   Number of groups =      138
Number of instruments = 47              Obs per group: min =       5
Wald chi2(9)   =   37427.45              avg   =      5.00
Prob > chi2    =       0.000              max   =       5
-----
```

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

	n						
	L1.	.9025721	.0412484	21.88	0.000	.8217267	.9834175

	w						
	--.	-.5397871	.1984403	-2.72	0.007	-.928723	-.1508513
	L1.	.3047706	.1800251	1.69	0.090	-.0480722	.6576134

	k						
	--.	.4734141	.0900715	5.26	0.000	.2968772	.6499511
	L1.	-.3942878	.086912	-4.54	0.000	-.5646322	-.2239433

	yr1978	.0347845	.0217776	1.60	0.110	-.0078988	.0774678
	yr1979	.044848	.0173516	2.58	0.010	.0108395	.0788565
	yr1980	.0291248	.0171671	1.70	0.090	-.004522	.0627716
	yr1982	.0333513	.0144621	2.31	0.021	.0050062	.0616964
	_cons	.8194633	.3304982	2.48	0.013	.1716988	1.467228

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).(L.n L.w L.k)

Instruments for levels equation

Standard

yr1977 yr1978 yr1979 yr1980 yr1981 yr1982

_cons

GMM-type (missing=0, separate instruments for each period unless collapsed)
D.(L.n L.w L.k)

Arellano-Bond test for AR(1) in first differences: z = -4.61 Pr > z = 0.000

Arellano-Bond test for AR(2) in first differences: z = -1.18 Pr > z = 0.238

Sargan test of overid. restrictions: chi2(37) = 86.05 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(37) = 52.82 Prob > chi2 = 0.044
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:

GMM instruments for levels

Hansen test excluding group: chi2(25) = 35.67 Prob > chi2 = 0.077

Difference (null H = exogenous): chi2(12) = 17.15 Prob > chi2 = 0.144

iv(yr1977 yr1978 yr1979 yr1980 yr1981 yr1982, eq(level))

Hansen test excluding group: chi2(33) = 44.68 Prob > chi2 = 0.084

Difference (null H = exogenous): chi2(4) = 8.14 Prob > chi2 = 0.087

SGMM Two-Step (Blundell-Bond):

Dynamic panel-data estimation, two-step system GMM

```
-----
Group variable: id                      Number of obs   =      690
Time variable : year                    Number of groups =      138
Number of instruments = 47              Obs per group: min =       5
Wald chi2(9)  =  30749.14                avg          =    5.00
Prob > chi2    =    0.000                  max          =       5
-----
```

	n	Coefficient	Corrected std. err.	z	P>|z|	[95% conf. interval]	
n							
L1.		.892057	.0524149	17.02	0.000	.7893258	.9947883
w							
--.		-.4138471	.2405795	-1.72	0.085	-.8853744	.0576801
L1.		.23221	.1663529	1.40	0.163	-.0938358	.5582558
k							
--.		.4563271	.1222931	3.73	0.000	.2166371	.6960171
L1.		-.3582417	.1210988	-2.96	0.003	-.595591	-.1208924
yr1978		.0405244	.0265643	1.53	0.127	-.0115406	.0925895
yr1979		.0513874	.0198615	2.59	0.010	.0124596	.0903151
yr1980		.0296077	.0200915	1.47	0.141	-.0097708	.0689863
yr1982		.0290802	.014089	2.06	0.039	.0014662	.0566942
_cons		.6712912	.3744471	1.79	0.073	-.0626117	1.405194

Instruments for first differences equation

GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/5).(L.n L.w L.k)

Instruments for levels equation

Standard

yr1977 yr1978 yr1979 yr1980 yr1981 yr1982

_cons

GMM-type (missing=0, separate instruments for each period unless collapsed)
D.(L.n L.w L.k)

Arellano-Bond test for AR(1) in first differences: z = -4.46 Pr > z = 0.000

Arellano-Bond test for AR(2) in first differences: z = -1.27 Pr > z = 0.203

Sargan test of overid. restrictions: chi2(37) = 86.05 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(37) = 52.82 Prob > chi2 = 0.044
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:

GMM instruments for levels

Hansen test excluding group: chi2(25) = 35.67 Prob > chi2 = 0.077

Difference (null H = exogenous): chi2(12) = 17.15 Prob > chi2 = 0.144

iv(yr1977 yr1978 yr1979 yr1980 yr1981 yr1982, eq(level))

Hansen test excluding group: chi2(33) = 44.68 Prob > chi2 = 0.084

Difference (null H = exogenous): chi2(4) = 8.14 Prob > chi2 = 0.087

Ejercicio 3.

Cuando hay muchos instrumentos, surgen dos problemas principales:

- Sobreestimación (overfitting) de la variable endógena.
- Mala estimación de la matriz de pesos W .

En estos casos, se proponen las siguientes soluciones:

- Probar diferentes especificaciones de IV recortando el número de rezagos en la matriz de instrumentos Z .
- Colapsar/combinar instrumentos. Se modifica la matriz de instrumentos para el individuo i :

$$Z_i = \begin{bmatrix} y_{i1} & 0 & 0 & \dots \\ y_{i1} & y_{i2} & 0 & \dots \\ y_{i3} & y_{i2} & y_{i1} & \dots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix}.$$

Si el modelo funciona, debería dar resultados similares con distintos instrumentos. Retomar el Ejercicio 2.e para ver una aplicación de esta cuestión. Estimar el modelo de empleo restringiendo el máximo rezago a 3 y 4 períodos. Por último, estimar el modelo colapsando instrumentos. Analizar si los resultados obtenidos son robustos.

Tabla comparativa:

	(1) GMM (OS) 2	(2) GMM (TS) 2	(3) GMM (OS) 3	(4) GMM (TS) 3	(5) GMM (OS) 4	(6) GMM (TS) 4	(7) GMM (OS) 5	(8) GMM (TS) 5
nL1	0.833*** (0.122)	0.940*** (0.189)	0.949*** (0.182)	0.900*** (0.226)	0.847*** (0.121)	0.930*** (0.174)	1.108*** (0.387)	0.877* (0.455)
N	414	414	414	414	414	414	414	414

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Ejercicio 4.

Considerar, nuevamente, el modelo del primer ejercicio. Obtener el estimador LSDVC propuesto por Kiviet (1995) a partir del comando `xtlsdvc`. Luego, estimar la matriz de varianzas y covarianzas de los coeficientes de Kiviet siguiendo el procedimiento explicado en clase.

LSDVC (Kiviet):

LSDVC dynamic regression
(SE not computed)

n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]
n					
L1.	.9890308	.	.	.	.

LSDVC (Kiviet):

LSDVC dynamic regression
(SE not computed)

n	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]
n					
L1.	.7863675	.	.	.	.
yr1978	.1430045	.	.	.	.
yr1979	.1365801	.	.	.	.
yr1980	.0957011	.	.	.	.
yr1981	.0105706	.	.	.	.