



**MESTRADO EM
ECONOMETRIA APLICADA E PREVISÃO
MICROECONOMETRIA I**

**Aplicação Empírica:
MODELOS DINÂMICOS**

**Isabel Proença
Luís Silveira Santos**

1. Instalação de packages úteis

```
ssc install xtabond2
```

2. Ler dados

```
use blundbondbalanc_usbal89v2.dta, clear
```

2.1. Declara base de dados como painel

```
xtset id year
```

```
panel variable: id (strongly balanced)
time variable: year, 1982 to 1989
delta: 1 year
```

3. Estatística descritiva no contexto de painel

```
xtdescribe
```

```
id: 886, 1030, ..., 989349      n =      492
year: 1982, 1983, ..., 1989    T =      8
Delta(year) = 1 year
Span(year) = 8 periods
(id*year uniquely identifies each observation)
```

```
Distribution of T_i:  min      5%      25%      50%      75%      95%      max
                   8        8        8        8        8        8        8
```

```
   Freq.  Percent  Cum. | Pattern
-----+-----
   492    100.00  100.00 | 11111111
-----+-----
   492    100.00      | XXXXXXXX
```

xtsum ly ln lk year

Variable		Mean	Std. Dev.	Min	Max	Observations
ly	overall	5.905447	1.991932	1.134937	11.67105	N = 3936
	between		1.976804	1.408586	11.49127	n = 492
	within		.2588288	4.189762	7.355696	T = 8
ln	overall	4.752687	2.283474	-2.253844	11.23016	N = 3936
	between		2.270097	-.8955042	11.14857	n = 492
	within		.2647287	3.152142	6.033032	T = 8
lk	overall	3.863383	2.081006	-1.295894	10.13477	N = 3936
	between		2.065382	-.3310543	9.906047	n = 492
	within		.2690222	2.357184	5.506763	T = 8
year	overall	1985.5	2.291579	1982	1989	N = 3936
	between		0	1985.5	1985.5	n = 492
	within		2.291579	1982	1989	T = 8

4. Regressões e inferência estatística

4.1. “Pooled OLS”, com desvios-padrão robustos

Sob as hipóteses clássicas, o erro composto é equiautocorrelacionado por blocos, devido à existência do efeito individual não observado.

```
reg ly l.ly ln l.ln lk l.lk D85-D89, robust cluster(id)
```

```
Linear regression                Number of obs   =       3,444
                                F(10, 491)      =      64189.42
                                Prob > F              =       0.0000
                                R-squared              =       0.9940
                                Root MSE           =       .15413
```

(Std. Err. adjusted for 492 clusters in id)

	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
ly						
L1.	.9549228	.0063588	150.17	0.000	.9424289	.9674167
ln						
--.	.4032651	.0237055	17.01	0.000	.3566884	.4498418
L1.	-.3787446	.023116	-16.38	0.000	-.4241632	-.333326
lk						
--.	.2762369	.0394051	7.01	0.000	.1988135	.3536603
L1.	-.2629995	.0398051	-6.61	0.000	-.3412089	-.1847901
D85	-.0162282	.0092101	-1.76	0.079	-.0343244	.0018679
D86	.0020344	.0096333	0.21	0.833	-.0168932	.020962
D87	.0456957	.0083061	5.50	0.000	.0293758	.0620155
D88	.0283299	.0077957	3.63	0.000	.0130128	.043647
D89	-.019879	.0080914	-2.46	0.014	-.0357771	-.0039809
_cons	.1075486	.0140298	7.67	0.000	.0799827	.1351145

→ Guardar o *output*:

```
estimates store POLS
```

4.2. “Random effects”

xtreg ly l.ly ln l.ln lk l.lk D85-D89, re

```

Random-effects GLS regression           Number of obs   =       3,444
Group variable: id                     Number of groups =        492

R-sq:                                  Obs per group:
    within = 0.6643                      min =           7
    between = 0.9992                     avg  =          7.0
    overall = 0.9940                     max  =           7

                                           Wald chi2(10)   =   564467.44
corr(u_i, X) = 0 (assumed)              Prob > chi2     =     0.0000

```

ly	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ly						
L1.	.9549228	.0055856	170.96	0.000	.9439753	.9658703
ln						
--.	.4032651	.0150251	26.84	0.000	.3738164	.4327139
L1.	-.3787446	.0152075	-24.91	0.000	-.4085508	-.3489384
lk						
--.	.2762369	.0276643	9.99	0.000	.2220159	.3304579
L1.	-.2629995	.0278997	-9.43	0.000	-.317682	-.208317
D85	-.0162282	.0086046	-1.89	0.059	-.0330929	.0006364
D86	.0020344	.0086261	0.24	0.814	-.0148725	.0189414
D87	.0456957	.008597	5.32	0.000	.0288459	.0625454
D88	.0283299	.0086217	3.29	0.001	.0114317	.0452281
D89	-.019879	.0086635	-2.29	0.022	-.0368592	-.0028988
_cons	.1075486	.0127425	8.44	0.000	.0825738	.1325235
sigma_u	0					
sigma_e	.13688086					
rho	0	(fraction of variance due to u_i)				

→ Guardar o *output*:

estimates store RE

NOTA:

As estimativas “Random effects” são iguais às estimativas “Pooled OLS”. Esta situação acontece quando a estimativa para a variância da heterogeneidade individual, σ_{η}^2 , é degenerada, isto é, $\hat{\sigma}_{\eta}^2 = 0$. Recordemos a transformação de efeitos aleatórios, quando os efeitos no tempo são fixos (*time dummies*):

$$y_{it}^* = y_{it} - \theta \bar{y}_{i\cdot},$$

onde

$$\theta = 1 - \frac{\sigma_v}{\sqrt{T\sigma_{\mu}^2 + \sigma_v^2}} \text{ e } \bar{y}_{i\cdot} = \frac{1}{T} \sum_{t=1}^T y_{it}$$

Sendo que $\hat{\sigma}_{\mu}^2 = 0$, então

$$\hat{\theta} = 1 - \frac{\sigma_v}{\sqrt{T \times 0 + \sigma_v^2}} = 0,$$

logo $y_{it}^* = y_{it}$, isto é, as variáveis transformadas são iguais às variáveis originais.

4.3. “Fixed effects”

```
xtreg ly l.ly ln l.ln lk l.lk D85-D89, fe robust cluster(id)
```

```
Fixed-effects (within) regression      Number of obs   =      3,444
Group variable: id                    Number of groups =      492
```

```
R-sq:                                Obs per group:
  within = 0.6957                      min =          7
  between = 0.9929                     avg =         7.0
  overall = 0.9884                     max =          7
```

```
F(10,491) = 354.42
corr(u_i, Xb) = 0.9027                Prob > F = 0.0000
```

(Std. Err. adjusted for 492 clusters in id)

	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
ly						
L1.	.5389381	.0231172	23.31	0.000	.4935173	.584359
ln						
--.	.3769492	.0249701	15.10	0.000	.3278878	.4260107
L1.	-.2058936	.0253065	-8.14	0.000	-.2556159	-.1561712
lk						
--.	.4266013	.085347	5.00	0.000	.258911	.5942917
L1.	-.3395489	.0771182	-4.40	0.000	-.4910712	-.1880265
D85	.0146888	.0087216	1.68	0.093	-.0024475	.031825
D86	.0297936	.0102001	2.92	0.004	.0097525	.0498348
D87	.0761801	.0092962	8.19	0.000	.0579149	.0944454
D88	.0922333	.0107569	8.57	0.000	.071098	.1133686
D89	.0635988	.0115088	5.53	0.000	.0409863	.0862113
_cons	1.532408	.0969649	15.80	0.000	1.341891	1.722925
sigma_u	.3993573					
sigma_e	.13688086					
rho	.89487099	(fraction of variance due to u_i)				

→ Guardar o *output*:

```
estimates store FE
```

4.4. Primeiras Diferenças

```
reg D.(ly l.ly ln l.ln lk l.lk D85-D89), nocons robust
cluster(id)
```

```
Linear regression                Number of obs   =      2,952
                                F(10, 491)      =      92.65
                                Prob > F              =      0.0000
                                R-squared              =      0.3326
                                Root MSE           =      .14912
```

(Std. Err. adjusted for 492 clusters in id)

		Robust				
D.ly	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ly						
LD.	-.0481349	.023618	-2.04	0.042	-.0945397	-.0017301
ln						
D1.	.3613453	.0269482	13.41	0.000	.3083974	.4142932
LD.	.0948679	.023779	3.99	0.000	.0481468	.141589
lk						
D1.	.6017026	.0937748	6.42	0.000	.4174531	.7859521
LD.	-.3178057	.0750133	-4.24	0.000	-.4651923	-.1704191
D85						
D1.	.0072105	.00775	0.93	0.353	-.0080168	.0224378
D86						
D1.	.0136521	.0123988	1.10	0.271	-.0107091	.0380133
D87						
D1.	.0607204	.0152415	3.98	0.000	.0307738	.090667
D88						
D1.	.1126837	.0176334	6.39	0.000	.0780376	.1473299
D89						
D1.	.1019289	.0194654	5.24	0.000	.0636831	.1401748

→ Guardar o *output*:

```
estimates store FD
```


4.5. Revisão dos resultados obtidos

estimates table FE FD, star(.1 .05 .01)

Variable	FE	FD
ly		
L1.	.53893815***	
LD.		-.0481349**
		← Estimativa para o sinal do enviesamento
ln		
--.	.37694922***	
L1.	-.20589356***	
D1.		.3613453***
LD.		.09486793***
lk		
--.	.42660133***	
L1.	-.33954886***	
D1.		.60170257***
LD.		-.31780568***
D85	.01468876*	
D86	.02979362***	
D87	.07618012***	
D88	.09223327***	
D89	.0635988***	
D85		
D1.		.00721047
D86		
D1.		.0136521
D87		
D1.		.06072037***
D88		
D1.		.11268374***
D89		
D1.		.10192894***

Legend: * p<.1; ** p<.05; *** p<.01

estimates table POLS RE FE, star(.1 .05 .01)

Variable	POLS	RE	FE
ly			
L1.	.95492282***	.95492282***	.53893815***
ln			
--.	.40326513***	.40326513***	.37694922***
L1.	-.37874461***	-.37874461***	-.20589356***
lk			
--.	.27623688***	.27623688***	.42660133***
L1.	-.26299951***	-.26299951***	-.33954886***
D85	-.01622825*	-.01622825*	.01468876*
D86	.00203443	.00203443	.02979362***
D87	.04569568***	.04569568***	.07618012***
D88	.02832991***	.02832991***	.09223327***
D89	-.01987897**	-.01987897**	.0635988***
_cons	.10754862***	.10754862***	1.5324082***

legend: * p<.1; ** p<.05; *** p<.01

4.6. Estimador de Arellano & Bond

4.6.1. GMM a 1 passo, com desvios-padrão robustos, variáveis estritamente exógenas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(ln lk D85-D89)
gmm(l.ly) robust noleveleg
```

Dynamic panel-data estimation, one-step difference GMM

```
-----
Group variable: id                Number of obs   =    2952
Time variable : year              Number of groups =    492
Number of instruments = 28        Obs per group:  min =     6
Wald chi2(10) = 1234.57          avg =          6.00
Prob > chi2   = 0.000           max =          6
-----
```

	ly	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
ly	L1.	.3607257	.094404	3.82	0.000	.1756972	.5457542
ln	--.	.3571752	.0363046	9.84	0.000	.2860196	.4283309
	L1.	-.2724825	.1588374	-1.72	0.086	-.583798	.038833
lk	--.	.2467726	.2049215	1.20	0.229	-.1548661	.6484114
	L1.	.0348403	.2254312	0.15	0.877	-.4069967	.4766773
D85		-.0039102	.0143686	-0.27	0.786	-.0320722	.0242518
D86		.0050872	.0170338	0.30	0.765	-.0282985	.0384729
D87		.0463691	.0276202	1.68	0.093	-.0077656	.1005038
D88		.0518713	.0416839	1.24	0.213	-.0298278	.1335703
D89		.0257267	.0456622	0.56	0.573	-.0637696	.1152229

```

Instruments for first differences equation
Standard
  D.(ln lk D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(1/7).L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -3.53 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.82 Pr > z = 0.410
-----
Sargan test of overid. restrictions: chi2(18) = 179.26 Prob > chi2 = 0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(18) = 111.55 Prob > chi2 = 0.000
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
iv(ln lk D85 D86 D87 D88 D89)
  Hansen test excluding group: chi2(11) = 60.07 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(7) = 51.48 Prob > chi2 = 0.000

```

→ Guardar o *output*:

estimates store AB1_R_Exo

NOTA:

Pretende-se estimar o seguinte modelo: $y_{it} = \rho y_{i,t-1} + \mathbf{X}_{it}\boldsymbol{\beta} + u_{it}$, com y_{it} vector $NT \times 1$, ρ é o parâmetro autorregressivo escalar, \mathbf{X}_{it} é matriz de regressores $NT \times K$, $\boldsymbol{\beta}$ é vector de parâmetros desconhecidos $K \times 1$ e $u_{it} = \eta_i + v_{it}$, com $\eta_i \sim N(0, \sigma_\eta^2)$ e $v_{it} \sim N(0, \sigma_v^2)$

1) Teste de Arellano-Bond (vd. Arellano & Bond, 1991), de autocorrelação de segunda ordem em Δv_{it} :

$$H_0 : E(\Delta v_{it} \Delta v_{i,t-2}) = 0 \quad \text{vs.} \quad H_1 : E(\Delta v_{it} \Delta v_{i,t-2}) \neq 0$$

Recorde-se que o estimador de Arellano e Bond é aquele que utiliza a equação às primeiras diferenças para estimar o modelo de interesse (elimina a heterogeneidade individual, η_i , através desta transformação). Ou seja, é utilizada a seguinte equação:

$$\begin{aligned} y_{it} - y_{i,t-1} &= \rho y_{i,t-1} + \mathbf{X}_{it}\boldsymbol{\beta} + u_{it} - (\rho y_{i,t-2} + \mathbf{X}_{i,t-1}\boldsymbol{\beta} + u_{i,t-1}) \Leftrightarrow \\ \Leftrightarrow y_{it} - y_{i,t-1} &= \rho (y_{i,t-1} - y_{i,t-2}) + (\mathbf{X}_{it} - \mathbf{X}_{i,t-1})\boldsymbol{\beta} + (u_{it} - u_{i,t-1}) \Leftrightarrow \\ \Leftrightarrow \Delta y_{it} &= \rho \Delta y_{i,t-1} + \Delta \mathbf{X}_{it}\boldsymbol{\beta} + \Delta u_{it} \end{aligned}$$

onde, $\Delta u_{it} = u_{it} - u_{i,t-1} = \eta_i + v_{it} - (\eta_i + v_{i,t-1}) = \eta_i - \eta_i + v_{it} - v_{i,t-1} = \Delta v_{it}$. Quando v_{it} não é autocorrelacionado então Δv_{it} é autocorrelacionado de primeira ordem:

$$\begin{aligned} E(\Delta v_{it} \Delta v_{i,t-1}) &= E[(v_{it} - v_{i,t-1})(v_{i,t-1} - v_{i,t-2})] = \\ &= E(v_{it}v_{i,t-1} - v_{it}v_{i,t-2} - v_{i,t-1}v_{i,t-1} + v_{i,t-1}v_{i,t-2}) = \\ &= E(v_{it}v_{i,t-1}) - E(v_{it}v_{i,t-2}) - E(v_{i,t-1}v_{i,t-1}) + E(v_{i,t-1}v_{i,t-2}) = \\ &= 0 - 0 - \text{Var}(v_{i,t-1}) + 0 = \\ &= -\text{Var}(v_{it}) = -\sigma_v^2 < 0 \end{aligned}$$

no entanto Δv_{it} não apresenta autocorrelação de segunda ordem:

$$\begin{aligned} E(\Delta v_{it} \Delta v_{i,t-2}) &= E[(v_{it} - v_{i,t-1})(v_{i,t-2} - v_{i,t-3})] = \\ &= E(v_{it}v_{i,t-2} - v_{it}v_{i,t-3} - v_{i,t-1}v_{i,t-2} + v_{i,t-1}v_{i,t-3}) = \\ &= E(v_{it}v_{i,t-2}) - E(v_{it}v_{i,t-3}) - E(v_{i,t-1}v_{i,t-2}) + E(v_{i,t-1}v_{i,t-3}) = \\ &= 0 - 0 - 0 + 0 = 0 \end{aligned}$$

No caso em que v_{it} for autocorrelacionado então Δv_{it} apresenta autocorrelação de segunda ordem.

2) Teste de Sargan e de Hansen:

Através do teste de Sargan é possível testar a validade dos instrumentos sobre-identificados, sob a hipótese de homocedasticidade condicionada e ausência de autocorrelação no erro idiossincrático:

$$\begin{cases} H_0 : \text{Condições de momentos para instrumentos sobre-identificados estão correctas} \\ H_1 : \text{Negação de } H_0 \end{cases}$$

$$m = \left(\Delta \hat{\mathbf{v}}^{(1)} \right)' \mathbf{Z} \left(\sum_{i=1}^N \mathbf{Z}_i' \mathbf{H}_i \mathbf{Z}_i \right)^{-1} \mathbf{Z}' \left(\Delta \hat{\mathbf{v}}^{(1)} \right)^a \sim \chi_{(p-K-1)}^2$$

onde $\Delta \hat{\mathbf{v}}^{(1)}$ são resíduos da estimação a um passo, \mathbf{Z} é a matriz de instrumentos $(T-2) \times p$ e \mathbf{H} é a matriz $(T-2) \times (T-2)$ de variâncias-covariâncias de $\Delta \mathbf{v}$ (as primeiras diferenças de v_{it} , supondo v_{it} homocedástico e sem autocorrelação) dividida por $\hat{\sigma}_v^2$.

Como será expectável, as hipóteses de homocedasticidade condicionada (do erro composto) e ausência de autocorrelação (no erro idiossincrático) dificilmente se verificam (em especial a hipótese de homocedasticidade condicionada). Assim sendo, o teste de Sargan não será robusto.

Salienta-se ainda que estudos de simulação (vd. Baltagi, 2013 e Roodman, 2006) mostram que a utilização de demasiadas condições de momentos provoca distorções no teste de Sargan, devido às estimativas da matriz de instrumentos serem fracas (para além dos instrumentos fracos). Por estes resultados, torna-se ambíguo o *Stata* considerar o teste de Sargan não vem enfraquecido.

Por sua vez, o teste de Hansen generaliza o teste de Sargan, na medida em que são utilizados os resíduos da estimação a dois passos, $\Delta \hat{\mathbf{v}}^{(2)}$ (através dos quais obtemos a matriz de ponderação ótima da estimação GMM):

$$J = \left(\Delta \hat{\mathbf{v}}^{(2)} \right)' \mathbf{Z} \left(\sum_{i=1}^N \mathbf{Z}_i' \left(\Delta \hat{\mathbf{v}}_i^{(2)} \right)' \left(\Delta \hat{\mathbf{v}}_i^{(2)} \right) \mathbf{Z}_i \right)^{-1} \mathbf{Z}' \left(\Delta \hat{\mathbf{v}}^{(2)} \right)^a \sim \chi_{(p-K-1)}^2$$

Neste caso, o teste será robusto. Note-se que, uma vez mais, estudos de simulação mostram que a utilização de demasiadas condições de momentos irão provocar distorções no teste de Hansen.

3) Teste diferencial de Hansen:

O teste diferencial de Hansen corresponde à diferença entre dois testes de Hansen:

$$DH = J - J_1 \sim \chi^2_{(p-p_1)}$$

com $p > p_1$. O termo J corresponde à estatística global do teste de Hansen para a situação em que se está a testar a validade de todos os instrumentos sobre-identificados e J_1 é a estatística do teste de Hansen para a situação em que se está a testar a validade de um conjunto de p_1 instrumentos sobre-identificados.

A diferença corresponderá a um teste à validade do subconjunto $p - p_1$ de instrumentos sobre-identificados.

4.6.2. GMM a 2 passos, sem correcção de Windmeijer, variáveis estritamente exógenas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(ln lk D85-D89)
gmm(l.ly) noleveleg twostep
```

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                Number of obs    =    2952
Time variable : year             Number of groups =    492
Number of instruments = 28       Obs per group: min =     6
Wald chi2(10) = 1390.01          avg =           6.00
Prob > chi2 = 0.000              max =           6
-----
```

	ly	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
-----+-----							
	ly						
L1.		.2579909	.0776479	3.32	0.001	.1058038	.4101781
	ln						
--.		.351696	.0320126	10.99	0.000	.2889524	.4144396
L1.		-.08922	.136251	-0.65	0.513	-.3562671	.1778271
	lk						
--.		-.2380191	.1794581	-1.33	0.185	-.5897505	.1137124
L1.		.4943994	.192347	2.57	0.010	.1174061	.8713926
D85		-.0319181	.0126418	-2.52	0.012	-.0566956	-.0071406
D86		-.0150941	.0154121	-0.98	0.327	-.0453013	.015113
D87		.0556096	.0242792	2.29	0.022	.0080233	.1031959
D88		.0569106	.0364868	1.56	0.119	-.0146021	.1284233
D89		.0289487	.0398036	0.73	0.467	-.049065	.1069624

Warning: Uncorrected two-step standard errors are unreliable.

Instruments for first differences equation

Standard

D.(ln lk D85 D86 D87 D88 D89)

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

L(1/7).L.ly

Arellano-Bond test for AR(1) in first differences: z = -2.92 Pr > z = 0.004

Arellano-Bond test for AR(2) in first differences: z = -1.06 Pr > z = 0.291

Sargan test of overid. restrictions: chi2(18) = 179.26 Prob > chi2 = 0.000

(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(18) = 111.55 Prob > chi2 = 0.000

(Robust, but weakened by many instruments.)

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

iv(ln lk D85 D86 D87 D88 D89)

Hansen test excluding group: chi2(11) = 60.07 Prob > chi2 = 0.000

Difference (null H = exogenous): chi2(7) = 51.48 Prob > chi2 = 0.000

→ Guardar o *output*:

estimates store AB2_NW_Exo

4.6.3. GMM a 2 passos, com correcção de Windmeijer, variáveis estritamente exógenas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(ln lk D85-D89)
gmm(l.ly) noleveleg twostep robust
```

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                Number of obs   =    2952
Time variable : year             Number of groups =    492
Number of instruments = 28        Obs per group: min =     6
Wald chi2(10) =    979.61         avg =    6.00
Prob > chi2   =     0.000         max =     6
-----
```

	Coef.	Corrected Std. Err.	z	P> z	[95% Conf. Interval]	
ly						
L1.	.2579909	.1553482	1.66	0.097	-.046486	.5624679
ln						
--.	.351696	.0548053	6.42	0.000	.2442795	.4591125
L1.	-.08922	.2305849	-0.39	0.699	-.5411582	.3627181
lk						
--.	-.2380191	.2493832	-0.95	0.340	-.7268012	.2507631
L1.	.4943994	.3316273	1.49	0.136	-.1555781	1.144377
D85	-.0319181	.0194909	-1.64	0.102	-.0701196	.0062834
D86	-.0150941	.023903	-0.63	0.528	-.0619432	.0317549
D87	.0556096	.0398656	1.39	0.163	-.0225254	.1337447
D88	.0569106	.0601591	0.95	0.344	-.0609992	.1748204
D89	.0289487	.0654539	0.44	0.658	-.0993385	.157236

```

Instruments for first differences equation
Standard
D.(ln lk D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
L(1/7).L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -1.51 Pr > z = 0.130
Arellano-Bond test for AR(2) in first differences: z = -0.97 Pr > z = 0.333
-----
Sargan test of overid. restrictions: chi2(18) = 179.26 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(18) = 111.55 Prob > chi2 = 0.000
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
iv(ln lk D85 D86 D87 D88 D89)
Hansen test excluding group: chi2(11) = 60.07 Prob > chi2 = 0.000
Difference (null H = exogenous): chi2(7) = 51.48 Prob > chi2 = 0.000

```

→ Guardar o *output*:

estimates store AB2_W_Exo

4.6.4. GMM a 2 passos, com correcção de Windmeijer, variáveis pré-determinadas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)
gmm(l.ly) gmm(ln lk) nolevel eq twostep robust
```

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                Number of obs   =    2952
Time variable : year              Number of groups =     492
Number of instruments = 80         Obs per group:  min =      6
Wald chi2(10) =    724.03          avg =           6.00
Prob > chi2    =     0.000         max =            6
-----
```

	Coef.	Corrected Std. Err.	z	P> z	[95% Conf. Interval]	
ly						
L1.	.263689	.1062724	2.48	0.013	.0553988	.4719791
ln						
--.	.1686736	.0948458	1.78	0.075	-.0172208	.354568
L1.	-.0130641	.0668589	-0.20	0.845	-.1441051	.117977
lk						
--.	.5975928	.457579	1.31	0.192	-.2992456	1.494431
L1.	-.3582566	.3431924	-1.04	0.297	-1.030901	.3143881
D85	.0056957	.0108402	0.53	0.599	-.0155508	.0269421
D86	.0115448	.0161518	0.71	0.475	-.0201121	.0432018
D87	.0426297	.0363588	1.17	0.241	-.0286323	.1138917
D88	.0786031	.0372441	2.11	0.035	.005606	.1516002
D89	.0636388	.0421646	1.51	0.131	-.0190024	.14628

Instruments for first differences equation

Standard

D.(D85 D86 D87 D88 D89)

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

L(1/7).(ln lk)

L(1/7).L.ly

Arellano-Bond test for AR(1) in first differences: z = -2.14 Pr > z = 0.032

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

Sargan test of overid. restrictions: chi2(70) = 329.89 Prob > chi2 = 0.000

(Not robust, but not weakened by many instruments.)

Hansen test of overid. restrictions: chi2(70) = 189.84 Prob > chi2 = 0.000

(Robust, but weakened by many instruments.)

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

gmm(L.ly, lag(1 .))

Hansen test excluding group: chi2(49) = 143.76 Prob > chi2 = 0.000

Difference (null H = exogenous): chi2(21) = 46.08 Prob > chi2 = 0.001

gmm(ln lk, lag(1 .))

Hansen test excluding group: chi2(16) = 81.91 Prob > chi2 = 0.000

Difference (null H = exogenous): chi2(54) = 107.93 Prob > chi2 = 0.000

iv(D85 D86 D87 D88 D89)

Hansen test excluding group: chi2(65) = 165.94 Prob > chi2 = 0.000

Difference (null H = exogenous): chi2(5) = 23.90 Prob > chi2 = 0.000

→ Guardar o *output*:

estimates store AB2_W_Pre

4.6.5. GMM a 2 passos, com correcção de Windmeijer, variáveis endógenas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)
gmm(l.ly) gmm(ln lk, lag(2 .)) nolevel eq twostep robust
```

Dynamic panel-data estimation, two-step difference GMM

```
-----
Group variable: id                Number of obs   =       2952
Time variable : year              Number of groups =        492
Number of instruments = 68         Obs per group: min =         6
Wald chi2(10) =       721.49       avg =        6.00
Prob > chi2   =         0.000       max =         6
-----
```

	Coef.	Corrected Std. Err.	z	P> z	[95% Conf. Interval]	
ly						
L1.	.3659584	.1183862	3.09	0.002	.1339256	.5979911
ln						
--.	.1595663	.1041746	1.53	0.126	-.044612	.3637447
L1.	-.0528153	.1173594	-0.45	0.653	-.2828356	.1772049
lk						
--.	.3901708	.4647875	0.84	0.401	-.5207959	1.301138
L1.	-.1666249	.3411393	-0.49	0.625	-.8352458	.5019959
D85	-.0101562	.0107406	-0.95	0.344	-.0312073	.010895
D86	-.0015185	.0154696	-0.10	0.922	-.0318384	.0288013
D87	.036866	.0377693	0.98	0.329	-.0371606	.1108925
D88	.0588645	.0407024	1.45	0.148	-.0209108	.1386398
D89	.03657	.047377	0.77	0.440	-.0562872	.1294271

```

Instruments for first differences equation
Standard
  D.(D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(2/7).(ln lk)
  L(1/7).L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -2.57 Pr > z = 0.010
Arellano-Bond test for AR(2) in first differences: z = -1.31 Pr > z = 0.190
-----
Sargan test of overid. restrictions: chi2(58) = 270.64 Prob > chi2 = 0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(58) = 165.51 Prob > chi2 = 0.000
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
gmm(L.ly, lag(1 .))
  Hansen test excluding group: chi2(37) = 121.69 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(21) = 43.82 Prob > chi2 = 0.002
gmm(ln lk, lag(2 .))
  Hansen test excluding group: chi2(16) = 82.50 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(42) = 83.01 Prob > chi2 = 0.000
iv(D85 D86 D87 D88 D89)
  Hansen test excluding group: chi2(53) = 149.88 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(5) = 15.64 Prob > chi2 = 0.008

```

→ Guardar o *output*:

estimates store AB2_W_End

4.7. Estimador de Blundell & Bond

4.7.1. GMM a 1 passo, com desvios-padrão robustos, variáveis pré-determinadas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)
gmm(l.ly) gmm(ln lk) robust
```

Dynamic panel-data estimation, one-step system GMM

```
-----
Group variable: id                Number of obs   =   3444
Time variable : year             Number of groups =    492
Number of instruments = 101      Obs per group: min =     7
Wald chi2(10) = 32531.41        avg =          7.00
Prob > chi2 = 0.000            max =          7
-----
```

		Robust				[95% Conf. Interval]	
ly	Coef.	Std. Err.	z	P> z			
ly							
L1.	.8929906	.0221431	40.33	0.000	.849591	.9363903	
ln							
--.	.4235704	.0261299	16.21	0.000	.3723567	.474784	
L1.	-.3513513	.0254912	-13.78	0.000	-.4013132	-.3013894	
lk							
--.	.3056063	.0468686	6.52	0.000	.2137455	.3974671	
L1.	-.2793262	.0479421	-5.83	0.000	-.3732911	-.1853614	
D85	-.0145902	.0091882	-1.59	0.112	-.0325987	.0034182	
D86	.0044502	.0095962	0.46	0.643	-.0143581	.0232584	
D87	.0485603	.0084196	5.77	0.000	.0320582	.0650624	
D88	.035345	.0087457	4.04	0.000	.0182038	.0524861	
D89	-.0114121	.0096189	-1.19	0.235	-.0302647	.0074406	
_cons	.1897415	.0434431	4.37	0.000	.1045947	.2748884	

```

Instruments for first differences equation
Standard
  D.(D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(1/7).(ln lk)
  L(1/7).L.ly
Instruments for levels equation
Standard
  D85 D86 D87 D88 D89
  _cons
GMM-type (missing=0, separate instruments for each period unless collapsed)
  D.(ln lk)
  D.L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -9.39 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.13 Pr > z = 0.260
-----
Sargan test of overid. restrictions: chi2(90) = 360.70 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(90) = 216.10 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(70) = 177.62 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(20) = 38.48 Prob > chi2 = 0.008
gmm(L.ly, lag(1 .))
  Hansen test excluding group: chi2(63) = 175.98 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(27) = 40.12 Prob > chi2 = 0.050
gmm(ln lk, lag(1 .))
  Hansen test excluding group: chi2(22) = 118.38 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(68) = 97.72 Prob > chi2 = 0.011
iv(D85 D86 D87 D88 D89)
  Hansen test excluding group: chi2(85) = 213.96 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(5) = 2.14 Prob > chi2 = 0.830

```

→ Guardar o *output*:

estimates store BB1_R_Pre

4.7.2. GMM a 2 passos, com correcção de Windmeijer, variáveis pré-determinadas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)
gmm(l.ly) gmm(ln lk) robust twostep
```

Dynamic panel-data estimation, two-step system GMM

```
-----
Group variable: id                Number of obs   =    3444
Time variable : year              Number of groups =     492
Number of instruments = 101        Obs per group:  min =      7
Wald chi2(10) = 24605.71           avg =          7.00
Prob > chi2 = 0.000                max =          7
-----
```

	Coef.	Corrected Std. Err.	z	P> z	[95% Conf. Interval]	
ly						
L1.	.9036462	.0285792	31.62	0.000	.847632	.9596604
ln						
--.	.4022506	.0330145	12.18	0.000	.3375434	.4669578
L1.	-.3399643	.0313528	-10.84	0.000	-.4014146	-.278514
lk						
--.	.2546666	.0604567	4.21	0.000	.1361737	.3731595
L1.	-.2300356	.0610962	-3.77	0.000	-.349782	-.1102893
D85	-.0246696	.0097939	-2.52	0.012	-.0438652	-.0054739
D86	.008147	.0097878	0.83	0.405	-.0110368	.0273308
D87	.0371509	.0091836	4.05	0.000	.0191514	.0551503
D88	.0291649	.0094761	3.08	0.002	.0105921	.0477378
D89	-.0206698	.0106621	-1.94	0.053	-.0415672	.0002276
_cons	.1903367	.0516716	3.68	0.000	.0890621	.2916112

```

Instruments for first differences equation
Standard
  D.(D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(1/7).(ln lk)
  L(1/7).L.ly
Instruments for levels equation
Standard
  D85 D86 D87 D88 D89
  _cons
GMM-type (missing=0, separate instruments for each period unless collapsed)
  D.(ln lk)
  D.L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -8.68 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.42 Pr > z = 0.156
-----
Sargan test of overid. restrictions: chi2(90) = 360.70 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(90) = 216.10 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(70) = 177.62 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(20) = 38.48 Prob > chi2 = 0.008
gmm(L.ly, lag(1 .))
  Hansen test excluding group: chi2(63) = 175.98 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(27) = 40.12 Prob > chi2 = 0.050
gmm(ln lk, lag(1 .))
  Hansen test excluding group: chi2(22) = 118.38 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(68) = 97.72 Prob > chi2 = 0.011
iv(D85 D86 D87 D88 D89)
  Hansen test excluding group: chi2(85) = 213.96 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(5) = 2.14 Prob > chi2 = 0.830

```

→ Guardar o *output*:

estimates store BB2_W_Pre

4.7.3. GMM a 2 passos, com correcção de Windmeijer, variáveis endógenas

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)  
gmm(l.ly, lag(2 .)) gmm(ln lk, lag(2 .)) robust twostep
```

Dynamic panel-data estimation, two-step system GMM

```
-----  
Group variable: id                Number of obs    =    3444  
Time variable : year              Number of groups =     492  
Number of instruments = 80         Obs per group:  min =      7  
Wald chi2(10) = 14748.06           avg =           7.00  
Prob > chi2    =      0.000        max =           7  
-----
```

	Coef.	Corrected Std. Err.	z	P> z	[95% Conf. Interval]	
ly						
L1.	.8494778	.0386191	22.00	0.000	.7737858	.9251698
ln						
--.	.4831333	.0738855	6.54	0.000	.3383203	.6279463
L1.	-.3994172	.0766808	-5.21	0.000	-.5497088	-.2491256
lk						
--.	.0782297	.0878465	0.89	0.373	-.0939463	.2504057
L1.	-.0146383	.0906699	-0.16	0.872	-.1923482	.1630715
D85	-.0319646	.0095612	-3.34	0.001	-.0507042	-.0132251
D86	.0044814	.0100757	0.44	0.656	-.0152667	.0242294
D87	.0431378	.0096607	4.47	0.000	.0242031	.0620725
D88	.0192073	.0098169	1.96	0.050	-.0000334	.038448
D89	-.0343525	.0116592	-2.95	0.003	-.0572041	-.011501
_cons	.2741216	.0676298	4.05	0.000	.1415697	.4066736

```

Instruments for first differences equation
Standard
  D.(D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(2/7).(ln lk)
  L(2/7).L.ly
Instruments for levels equation
Standard
  D85 D86 D87 D88 D89
  _cons
GMM-type (missing=0, separate instruments for each period unless collapsed)
  DL.(ln lk)
  DL.L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -8.16 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.19 Pr > z = 0.235
-----
Sargan test of overid. restrictions: chi2(69) = 226.16 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(69) = 171.13 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(51) = 132.24 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(18) = 38.89 Prob > chi2 = 0.003
gmm(L.ly, lag(2 .))
  Hansen test excluding group: chi2(50) = 137.15 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(19) = 33.98 Prob > chi2 = 0.018
gmm(ln lk, lag(2 .))
  Hansen test excluding group: chi2(14) = 20.97 Prob > chi2 = 0.102
  Difference (null H = exogenous): chi2(55) = 150.16 Prob > chi2 = 0.000
iv(D85 D86 D87 D88 D89)
  Hansen test excluding group: chi2(64) = 167.48 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(5) = 3.65 Prob > chi2 = 0.601

```

→ Guardar o *output*:

estimates store BB2_W_End

4.7.4. GMM a 2 passos, com correcção de Windmeijer, variáveis com padrão de endogeneidade grave

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)  
gmm(l.ly, lag(3 .)) gmm(ln lk, lag(3 .)) robust twostep
```

Dynamic panel-data estimation, two-step system GMM

```
-----  
Group variable: id                               Number of obs   =   3444  
Time variable : year                             Number of groups =    492  
Number of instruments = 60                       Obs per group: min =     7  
Wald chi2(10) = 27007.23                          avg =    7.00  
Prob > chi2 = 0.000                               max =     7  
-----
```

		Corrected				
	ly	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
	ly					
L1.		.9436161	.0435045	21.69	0.000	.8583489 1.028883
	ln					
--.		.1158596	.0750913	1.54	0.123	-.0313167 .263036
L1.		-.1031035	.0778615	-1.32	0.185	-.2557093 .0495022
	lk					
--.		.0976223	.0865112	1.13	0.259	-.0719366 .2671812
L1.		-.0524615	.0862948	-0.61	0.543	-.2215962 .1166732
	D85					
	D86					
	D87					
	D88					
	D89					
_cons		.1581968	.0566362	2.79	0.005	.0471919 .2692018

```

Instruments for first differences equation
Standard
  D.(D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(3/7).(ln lk)
  L(3/7).L.ly
Instruments for levels equation
Standard
  D85 D86 D87 D88 D89
  _cons
GMM-type (missing=0, separate instruments for each period unless collapsed)
  DL2.(ln lk)
  DL2.L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -7.49 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.64 Pr > z = 0.102
-----
Sargan test of overid. restrictions: chi2(49) = 107.44 Prob > chi2 = 0.000
(Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(49) = 90.64 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(34) = 49.49 Prob > chi2 = 0.042
  Difference (null H = exogenous):  chi2(15) = 41.15 Prob > chi2 = 0.000
gmm(L.ly, lag(3 .))
  Hansen test excluding group:      chi2(38) = 70.65 Prob > chi2 = 0.001
  Difference (null H = exogenous):  chi2(11) = 19.99 Prob > chi2 = 0.045
gmm(ln lk, lag(3 .))
  Hansen test excluding group:      chi2(6) = 4.43 Prob > chi2 = 0.618
  Difference (null H = exogenous):  chi2(43) = 86.21 Prob > chi2 = 0.000
iv(D85 D86 D87 D88 D89)
  Hansen test excluding group:      chi2(44) = 66.08 Prob > chi2 = 0.017
  Difference (null H = exogenous):  chi2(5) = 24.56 Prob > chi2 = 0.000

```

→ Guardar o *output*:

estimates store BB2_W_End2

4.7.5. GMM a 2 passos, com correcção de Windmeijer, variáveis com padrão de endogeneidade muito grave

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)  
gmm(l.ly, lag(4 .)) gmm(ln lk, lag(4 .)) robust twostep
```

Dynamic panel-data estimation, two-step system GMM

```
-----  
Group variable: id                Number of obs    =    3444  
Time variable : year             Number of groups =    492  
Number of instruments = 43        Obs per group:  min =     7  
Wald chi2(10) = 21213.99          avg =           7.00  
Prob > chi2    =    0.000         max =           7  
-----
```

		Corrected				
	ly	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
	ly					
L1.		.9833622	.0417485	23.55	0.000	.9015366 1.065188
	ln					
--.		.2557388	.1254398	2.04	0.041	.0098814 .5015962
L1.		-.2671557	.1202421	-2.22	0.026	-.502826 -.0314855
	lk					
--.		.0883515	.0898293	0.98	0.325	-.0877108 .2644138
L1.		-.0690573	.095936	-0.72	0.472	-.2570884 .1189739
	D85					
		-.0545872	.0115012	-4.75	0.000	-.0771292 -.0320452
	D86					
		-.0285395	.0141852	-2.01	0.044	-.0563419 -.0007371
	D87					
		.0201869	.0112856	1.79	0.074	-.0019324 .0423062
	D88					
		.0057823	.0100815	0.57	0.566	-.013977 .0255415
	D89					
		-.0476441	.0110362	-4.32	0.000	-.0692747 -.0260135
	_cons					
		.1267245	.0698956	1.81	0.070	-.0102683 .2637174

```

Instruments for first differences equation
Standard
  D.(D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(4/7).(ln lk)
  L(4/7).L.ly
Instruments for levels equation
Standard
  D85 D86 D87 D88 D89
  _cons
GMM-type (missing=0, separate instruments for each period unless collapsed)
  DL3.(ln lk)
  DL3.L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -8.18 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.39 Pr > z = 0.163
-----
Sargan test of overid. restrictions: chi2(32) = 57.21 Prob > chi2 = 0.004
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(32) = 46.39 Prob > chi2 = 0.048
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
GMM instruments for levels
  Hansen test excluding group: chi2(20) = 26.59 Prob > chi2 = 0.147
  Difference (null H = exogenous): chi2(12) = 19.79 Prob > chi2 = 0.071
gmm(L.ly, lag(4 .))
  Hansen test excluding group: chi2(27) = 33.45 Prob > chi2 = 0.183
  Difference (null H = exogenous): chi2(5) = 12.94 Prob > chi2 = 0.024
gmm(ln lk, lag(4 .))
  Hansen test excluding group: chi2(0) = 0.00 Prob > chi2 = .
  Difference (null H = exogenous): chi2(32) = 46.39 Prob > chi2 = 0.048
iv(D85 D86 D87 D88 D89)
  Hansen test excluding group: chi2(27) = 35.32 Prob > chi2 = 0.131
  Difference (null H = exogenous): chi2(5) = 11.07 Prob > chi2 = 0.050

```

→ Guardar o *output*:

estimates store BB2_W_End3

4.7.6. GMM a 2 passos, com correcção de Windmeijer, variáveis com padrão de endogeneidade muito grave (2 períodos)

```
xtabond2 ly l.ly ln l.ln lk l.lk D85-D89, iv(D85-D89)
gmm(l.ly, lag(4 5)) gmm(ln, lag(4 5)) gmm(lk, lag(4 5))
robust twostep
```

Dynamic panel-data estimation, two-step system GMM

```
-----
Group variable: id                Number of obs    =    3444
Time variable : year              Number of groups  =     492
Number of instruments = 36         Obs per group: min =      7
Wald chi2(10) = 15496.51          avg =           7.00
Prob > chi2 = 0.000              max =           7
-----
```

		Corrected				
	ly	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
	ly					
L1.		1.00054	.0466697	21.44	0.000	.9090693 1.092011
	ln					
--.		.1964188	.1160436	1.69	0.091	-.0310225 .42386
L1.		-.213861	.1170393	-1.83	0.068	-.4432538 .0155318
	lk					
--.		.0858132	.0893386	0.96	0.337	-.0892872 .2609135
L1.		-.0805152	.0951348	-0.85	0.397	-.2669759 .1059455
	D85					
	D86					
	D87					
	D88					
	D89					
	_cons					

```

Instruments for first differences equation
Standard
  D.(D85 D86 D87 D88 D89)
GMM-type (missing=0, separate instruments for each period unless collapsed)
  L(4/5).lk
  L(4/5).ln
  L(4/5).L.ly
Instruments for levels equation
Standard
  D85 D86 D87 D88 D89
  _cons
GMM-type (missing=0, separate instruments for each period unless collapsed)
  DL3.lk
  DL3.ln
  DL3.L.ly
-----
Arellano-Bond test for AR(1) in first differences: z = -7.92 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.47 Pr > z = 0.140
-----
Sargan test of overid. restrictions: chi2(25) = 38.94 Prob > chi2 = 0.037
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(25) = 28.14 Prob > chi2 = 0.301
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
GMM instruments for levels
  Hansen test excluding group: chi2(12) = 11.16 Prob > chi2 = 0.515
  Difference (null H = exogenous): chi2(13) = 16.99 Prob > chi2 = 0.200
gmm(L.ly, lag(4 5))
  Hansen test excluding group: chi2(21) = 24.70 Prob > chi2 = 0.260
  Difference (null H = exogenous): chi2(4) = 3.44 Prob > chi2 = 0.486
gmm(ln, lag(4 5))
  Hansen test excluding group: chi2(13) = 22.41 Prob > chi2 = 0.000
  Difference (null H = exogenous): chi2(12) = 5.73 Prob > chi2 = 0.929
gmm(lk, lag(4 5))
  Hansen test excluding group: chi2(11) = 10.45 Prob > chi2 = 0.491
  Difference (null H = exogenous): chi2(14) = 17.70 Prob > chi2 = 0.221
iv(D85 D86 D87 D88 D89)
  Hansen test excluding group: chi2(20) = 22.73 Prob > chi2 = 0.302
  Difference (null H = exogenous): chi2(5) = 5.41 Prob > chi2 = 0.368

```

→ Guardar o *output*:

estimates store BB2_W_End4

4.8. Revisão dos resultados obtidos

`estimates table AB*, star(.1 .05 .01)`

Variable	AB1_R_Exo	AB2_NW_Exo	AB2_W_Exo	AB2_W_Pre	AB2_W_End
ly					
L1.	.36072567***	.25799093***	.25799093*	.26368897**	.36595836***
ln					
--.	.35717523***	.35169603***	.35169603***	.1686736*	.15956634
L1.	-.27248254*	-.08922002	-.08922002	-.01306406	-.05281532
lk					
--.	.24677264	-.23801906	-.23801906	.59759284	.39017085
L1.	.03484028	.49439937**	.49439937	-.35825665	-.16662494
D85	-.00391024	-.03191809**	-.03191809	.00569565	-.01015616
D86	.00508719	-.01509415	-.01509415	.01154484	-.00151855
D87	.04636913*	.05560961**	.05560961	.04262972	.03686598
D88	.05187125	.0569106	.0569106	.07860308**	.0588645
D89	.02572667	.02894871	.02894871	.06363883	.03656995

legend: * p<.1; ** p<.05; *** p<.01

estimates table BB*, star(.1 .05 .01)

Variable	BB1_R_Pre	BB2_W_Pre	BB2_W_End	BB2_W_End2	BB2_W_End3	BB2_W_End4
ly						
L1.	.89299064***	.90364619***	.84947777***	.94361609***	.98336222***	1.0005402***
ln						
--.	.42357038***	.40225061***	.48313327***	.11585963	.25573881**	.19641878*
L1.	-.35135132***	-.33996429***	-.39941724***	-.10310352	-.26715571**	-.213861*
lk						
--.	.3056063***	.25466661***	.07822969	.09762232	.08835151	.08581318
L1.	-.27932622***	-.23003565***	-.01463834	-.05246152	-.06905725	-.08051522
D85	-.01459023	-.02466959**	-.0319646***	-.06485662***	-.05458718***	-.05689915***
D86	.00445017	.00814699	.00448135	-.03972942***	-.02853952**	-.03304735**
D87	.04856031***	.03715088***	.04313783***	.00901953	.02018689*	.02049521*
D88	.03534497***	.02916492***	.01920726*	-.00566699	.00578226	.00345325
D89	-.01141206	-.02066982*	-.03435253***	-.05317892***	-.04764412***	-.04468948***
_cons	.18974151***	.19033666***	.27412162***	.15819682***	.12672454*	.10947944

legend: * p<.1; ** p<.05; *** p<.01

```
estimates table FE RE BB2_W_End4, star(.1 .05 .01)
```

Variable	FE	RE	BB2_W_End4
ly			
L1.	.53893815***	.95492282***	1.0005402***
ln			
--.	.37694922***	.40326513***	.19641878*
L1.	-.20589356***	-.37874461***	-.213861*
lk			
--.	.42660133***	.27623688***	.08581318
L1.	-.33954886***	-.26299951***	-.08051522
D85	.01468876*	-.01622825*	-.05689915***
D86	.02979362***	.00203443	-.03304735**
D87	.07618012***	.04569568***	.02049521*
D88	.09223327***	.02832991***	.00345325
D89	.0635988***	-.01987897**	-.04468948***
_cons	1.5324082***	.10754862***	.10947944

legend: * p<.1; ** p<.05; *** p<.01

NOTA: estudos de simulação mostram que as estimativas obtidas através do estimador “*Fixed effects*” são negativamente enviesadas e as estimativas obtidas através do estimador “*Random effects*” são positivamente enviesadas. Logo, a estimativa consistente deverá situar-se entre as estimativas “*Fixed effects*” e as estimativas “*Random effects*”. No entanto, como é possível observar, na prática esta relação dificilmente se verifica.

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