**Trabajo Práctico N° 4:**

**Extensiones de Diferencias en Diferencias.**

**Ejercicio 1: Static Two-Way Fixed Effects.**

*Una forma de extender el framework de diferencias en diferencias cuando hay más períodos temporales disponibles es utilizar efectos fijos temporales adicionalmente a los efectos fijos por individuo. Es decir, si el resultado de interés es Y y el tratamiento está definido por D, entonces, se puede estimar la ecuación:*

*= + + +* ***(1)***

*donde son efectos fijos por individuo, son efectos fijos temporales.*

**(a)** *¿Cómo debe definirse para que esto sea la generalización de la ecuación de DiD 2x2?*

= {i tratado}{t fecha de otorgamiento del tratamiento}.

**(b)** *Escribir cómo queda la variable si T= 3 y N= 3 con la unidad 1 sin tratar, la unidad 2 tratada en el período 1, la unidad 3 tratada en el período 2.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **id** | **t** | **Cuándo** |  |  |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 2 | 0 | 0 | 0 |
| 1 | 3 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 |
| 2 | 2 | 1 | 1 | 1 |
| 2 | 3 | 1 | 1 | 1 |
| 3 | 1 | 2 | 1 | 0 |
| 3 | 2 | 2 | 1 | 1 |
| 3 | 3 | 2 | 1 | 1 |

**(c)** *¿Cuál es la expresión del estimador de ?*

La expresión del estimador de es:

= .

**(d)** *¿Cuándo podría este estimador ser bueno para recuperar el efecto promedio de tratamiento sobre los tratados? ¿Qué problemas podría tener esta especificación?*

Este estimador podría ser bueno para recuperar el efecto promedio de tratamiento sobre los tratados cuando todas las unidades tienen el mismo efecto de tratamiento y cuando éste es idéntico independientemente de cuánto tiempo haya pasado desde que comenzó el tratamiento. Entonces, los problemas que podría tener esta especificación es heterogeneidad en efecto de tratamiento en términos de unidades de corte transversal y tiempo transcurrido desde el tratamiento.

**(e)** *Utilizando la base de datos “organ\_donations.dta” de Kessler & Roth (2014), estimar el coeficiente de esta especificación.*

HDFE Linear regression Number of obs = 162

Absorbing 2 HDFE groups F( 1, 26) = 13.42

Statistics robust to heteroskedasticity Prob > F = 0.0011

R-squared = 0.9793

Adj R-squared = 0.9742

Within R-sq. = 0.0092

Number of clusters (state) = 27 Root MSE = 0.0246

(Std. err. adjusted for 27 clusters in state)

------------------------------------------------------------------------------

| Robust

rate | Coefficient std. err. t P>|t| [95% conf. interval]

-------------+----------------------------------------------------------------

D | -.022459 .0061312 -3.66 0.001 -.0350619 -.0098561

\_cons | .4454641 .0001135 3923.36 0.000 .4452307 .4456974

------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

state | 27 27 0 \*|

quarter | 6 1 5 |

-----------------------------------------------------+

\* = FE nested within cluster; treated as redundant for DoF computation

**Ejercicio 2: Dynamic Two-Way Fixed Effects.**

*Con la especificación anterior, se estima un único efecto de tratamiento.Sin embargo, si se posee informacion de varios períodos, ésta podrá utilizarse para evaluar, por un lado, cómo cambian los efectos en el tiempo y, por otro, evaluar cómo se comportaba la variable de interés previo del otorgamiento del tratamiento. La especificación dinámica de TWFE es:*

*= + + + .*

**(a)** *Escribir cómo quedan las variables si T= 3 y N= 3 con la unidad 1 sin tratar, la unidad 2 tratada en el período 1, la unidad 3 tratada en el período 2.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **id** | **t** | **Cuándo** |  |  | **t(-1)** | **t(0)** | **t(+1)** | **t(+2)** |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 2 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 3 | 1 | 2 | 1 | 0 | 1 | 0 | 0 | 0 |
| 3 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 0 |
| 3 | 3 | 2 | 1 | 1 | 0 | 0 | 1 | 0 |

**(b)** *Computar los efectos de tratamiento dinámicos . Notar que se normaliza = 0. (¿Por qué?).*

HDFE Linear regression Number of obs = 162

Absorbing 2 HDFE groups F( 5, 26) = 5.79

Statistics robust to heteroskedasticity Prob > F = 0.0010

R-squared = 0.9793

Adj R-squared = 0.9734

Within R-sq. = 0.0098

Number of clusters (state) = 27 Root MSE = 0.0250

(Std. err. adjusted for 27 clusters in state)

----------------------------------------------------------------------------------------

| Robust

rate | Coefficient std. err. t P>|t| [95% conf. interval]

-----------------------+----------------------------------------------------------------

1.California | 0 (omitted)

|

quarter\_num |

Quarter 4 2010 | 0 (omitted)

Quarter 1 2011 | 0 (omitted)

Quarter 3 2011 | 0 (omitted)

Quarter 4 2011 | 0 (omitted)

Quarter 1 2012 | 0 (omitted)

|

California#quarter\_num |

1#Quarter 4 2010 | -.0029423 .0050842 -0.58 0.568 -.013393 .0075084

1#Quarter 1 2011 | .0062961 .0022658 2.78 0.010 .0016388 .0109535

1#Quarter 3 2011 | -.0215654 .0050337 -4.28 0.000 -.0319124 -.0112184

1#Quarter 4 2011 | -.0202923 .0044733 -4.54 0.000 -.0294874 -.0110973

1#Quarter 1 2012 | -.0221654 .0100132 -2.21 0.036 -.0427479 -.0015829

|

\_cons | .4454226 .0001052 4232.23 0.000 .4452063 .445639

----------------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

state | 27 27 0 \*|

quarter\_num | 6 1 5 |

-----------------------------------------------------+

\* = FE nested within cluster; treated as redundant for DoF computation

**(c)** *Graficar los efectos de tratamiento pre y post otorgamiento junto con sus intervalos de confianza.*



**(d)** *Utilizar los datos de los períodos anteriores al tratamiento para hacer un “test de placebo”:*

* *Utilizar sólo los datos que llegaron antes de que el tratamiento entrara en vigor.*
* *Elegir un período de tratamiento falso.*
* *Calcular el mismo modelo de diferencias en diferencias que se planeaba usar (por ejemplo), pero crear la variable igual a 1 si está en el grupo tratado y después de la fecha de tratamiento falso que se eligió.*
* *Si se encuentra un “efecto” para esa fecha de tratamiento donde, realmente, no debería haberlo, eso es evidencia de que hay algo mal con el diseño, lo que puede implicar una violación de tendencias paralelas.*

HDFE Linear regression Number of obs = 81

Absorbing 2 HDFE groups F( 1, 26) = 1.43

Statistics robust to heteroskedasticity Prob > F = 0.2421

R-squared = 0.9938

Adj R-squared = 0.9902

Within R-sq. = 0.0019

Number of clusters (state) = 27 Root MSE = 0.0156

(Std. err. adjusted for 27 clusters in state)

------------------------------------------------------------------------------

| Robust

rate | Coefficient std. err. t P>|t| [95% conf. interval]

-------------+----------------------------------------------------------------

FakeTreat1 | .0060904 .0050881 1.20 0.242 -.0043684 .0165492

\_cons | .4383509 .0001256 3489.15 0.000 .4380926 .4386091

------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

state | 27 27 0 \*|

quarter | 3 1 2 |

-----------------------------------------------------+

\* = FE nested within cluster; treated as redundant for DoF computation

HDFE Linear regression Number of obs = 81

Absorbing 2 HDFE groups F( 1, 26) = 0.36

Statistics robust to heteroskedasticity Prob > F = 0.5540

R-squared = 0.9938

Adj R-squared = 0.9902

Within R-sq. = 0.0001

Number of clusters (state) = 27 Root MSE = 0.0156

(Std. err. adjusted for 27 clusters in state)

------------------------------------------------------------------------------

| Robust

rate | Coefficient std. err. t P>|t| [95% conf. interval]

-------------+----------------------------------------------------------------

FakeTreat2 | -.0016769 .0027968 -0.60 0.554 -.0074259 .004072

\_cons | .4385219 .0000345 1.3e+04 0.000 .438451 .4385929

------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

state | 27 27 0 \*|

quarter | 3 1 2 |

-----------------------------------------------------+

\* = FE nested within cluster; treated as redundant for DoF computation

Por lo tanto, no se encuentra un efecto estadísticamente significativo para estas fechas de tratamiento falsas, por lo que es evidencia de que el diseño está bien hecho.

**Ejercicio 3: Callaway & Sant’Anna y csdid.**

*Una solución a los problemas de TWFE es la que proponen Callaway & Sant’Anna (2020). Ellos proponen computar todos los ATT válidos y ponderarlos adecuadamente. En Stata, esto se puede hacer con el comando csdid. Utilizando la base de datos “mpdta.dta”, se busca estimar el impacto de una suba del salario mínimo en el empleo joven.*

**(a)** *Estimar todos los ATT (g, t) sin variables explicativas.*

Estimación (sin variables explicativas y sin utilizar el grupo de los no tratados todavía):

Difference-in-difference with Multiple Time Periods

Number of obs = 2,500

Outcome model : least squares

Treatment model: inverse probability

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

g2004 |

t\_2003\_2004 | -.0105032 .023251 -0.45 0.651 -.0560744 .0350679

t\_2003\_2005 | -.0704232 .0309848 -2.27 0.023 -.1311522 -.0096941

t\_2003\_2006 | -.1372587 .0364357 -3.77 0.000 -.2086713 -.0658461

t\_2003\_2007 | -.1008114 .0343592 -2.93 0.003 -.1681542 -.0334685

-------------+----------------------------------------------------------------

g2006 |

t\_2003\_2004 | .0065201 .0233268 0.28 0.780 -.0391996 .0522398

t\_2004\_2005 | -.0027508 .0195586 -0.14 0.888 -.0410849 .0355833

t\_2005\_2006 | -.0045946 .0177552 -0.26 0.796 -.0393942 .0302049

t\_2005\_2007 | -.0412245 .0202292 -2.04 0.042 -.0808729 -.001576

-------------+----------------------------------------------------------------

g2007 |

t\_2003\_2004 | .0305067 .0150336 2.03 0.042 .0010414 .0599719

t\_2004\_2005 | -.0027259 .0163958 -0.17 0.868 -.0348611 .0294093

t\_2005\_2006 | -.0310871 .0178775 -1.74 0.082 -.0661264 .0039522

t\_2006\_2007 | -.0260544 .0166554 -1.56 0.118 -.0586985 .0065896

------------------------------------------------------------------------------

Control: Never Treated

See Callaway and Sant'Anna (2021) for details

**(b)** *Evaluar si es plausible el efecto de tendencias paralelas en base a las tendencias previas al otorgamiento del tratamiento. ¿Puede haber habido factores que hayan afectado la evolución del empleo en todos los estados tratados que no se deba al otorgamiento del tratamiento? Reflexionar acerca del rol de la forma funcional de las variables (por ejemplo, en niveles vs. en logaritmos).*

Test para tendencias paralelas (sin variables explicativas y sin utilizar el grupo de los no tratados todavía):

Pretrend Test. H0 All Pre-treatment are equal to 0

chi2(5) = 7.7912

p-value = 0.1681

**(c)** *Computar el efecto agregado simple, el efecto agregado por grupos, el efecto agregado por período y el efecto agregado por períodos tras el otorgamiento del tratamiento.*

Efecto agregado simple (sin variables explicativas y sin utilizar el grupo de los no tratados todavía):

Average Treatment Effect on Treated

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

ATT | -.0399513 .012034 -3.32 0.001 -.0635375 -.016365

------------------------------------------------------------------------------

Efecto agregado por grupos (sin variables explicativas y sin utilizar el grupo de los no tratados todavía):

ATT by group

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

GAverage | -.0310183 .0123872 -2.50 0.012 -.0552967 -.0067399

G2004 | -.0797491 .0263678 -3.02 0.002 -.1314291 -.0280692

G2006 | -.0229095 .0167033 -1.37 0.170 -.0556475 .0098284

G2007 | -.0260544 .0166554 -1.56 0.118 -.0586985 .0065896

------------------------------------------------------------------------------

Efecto agregado por período (sin variables explicativas y sin utilizar el grupo de los no tratados todavía):

ATT by Calendar Period

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

CAverage | -.0417004 .0159719 -2.61 0.009 -.0730047 -.0103962

T2004 | -.0105032 .023251 -0.45 0.651 -.0560744 .0350679

T2005 | -.0704232 .0309848 -2.27 0.023 -.1311522 -.0096941

T2006 | -.048816 .0201259 -2.43 0.015 -.0882619 -.00937

T2007 | -.0370593 .0137471 -2.70 0.007 -.0640031 -.0101156

------------------------------------------------------------------------------

Efecto agregado por períodos tras el otorgamiento del tratamiento (sin variables explicativas y sin utilizar el grupo de los no tratados todavía):

ATT by Periods Before and After treatment

Event Study:Dynamic effects

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

Pre\_avg | .0018283 .007657 0.24 0.811 -.0131791 .0168357

Post\_avg | -.0772398 .019965 -3.87 0.000 -.1163705 -.0381092

Tm3 | .0305067 .0150336 2.03 0.042 .0010414 .0599719

Tm2 | -.0005631 .0132916 -0.04 0.966 -.0266142 .0254881

Tm1 | -.0244587 .0142364 -1.72 0.086 -.0523616 .0034441

Tp0 | -.0199318 .0118264 -1.69 0.092 -.0431111 .0032474

Tp1 | -.0509574 .0168935 -3.02 0.003 -.084068 -.0178468

Tp2 | -.1372587 .0364357 -3.77 0.000 -.2086713 -.0658461

Tp3 | -.1008114 .0343592 -2.93 0.003 -.1681542 -.0334685

------------------------------------------------------------------------------

**(d)** *Repetir los incisos anteriores condicionando en la variable de población.*

Estimación (con variables explicativas y sin utilizar el grupo de los no tratados todavía):

Difference-in-difference with Multiple Time Periods

Number of obs = 2,500

Outcome model : least squares

Treatment model: inverse probability

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

g2004 |

t\_2003\_2004 | -.0145297 .0221292 -0.66 0.511 -.057902 .0288427

t\_2003\_2005 | -.0764219 .0286713 -2.67 0.008 -.1326166 -.0202271

t\_2003\_2006 | -.1404483 .0353782 -3.97 0.000 -.2097882 -.0711084

t\_2003\_2007 | -.1069039 .0328865 -3.25 0.001 -.1713602 -.0424476

-------------+----------------------------------------------------------------

g2006 |

t\_2003\_2004 | -.0004721 .0222234 -0.02 0.983 -.0440293 .043085

t\_2004\_2005 | -.0062025 .0184957 -0.34 0.737 -.0424534 .0300484

t\_2005\_2006 | .0009606 .0194002 0.05 0.961 -.0370631 .0389843

t\_2005\_2007 | -.0412939 .0197211 -2.09 0.036 -.0799466 -.0026411

-------------+----------------------------------------------------------------

g2007 |

t\_2003\_2004 | .0267278 .0140657 1.90 0.057 -.0008404 .054296

t\_2004\_2005 | -.0045766 .0157178 -0.29 0.771 -.0353828 .0262297

t\_2005\_2006 | -.0284475 .0181809 -1.56 0.118 -.0640814 .0071864

t\_2006\_2007 | -.0287814 .016239 -1.77 0.076 -.0606091 .0030464

------------------------------------------------------------------------------

Control: Never Treated

See Callaway and Sant'Anna (2021) for details

Test para tendencias paralelas (con variables explicativas y sin utilizar el grupo de los no tratados todavía):

Pretrend Test. H0 All Pre-treatment are equal to 0

chi2(5) = 6.8418

p-value = 0.2327

Efecto agregado simple (con variables explicativas y sin utilizar el grupo de los no tratados todavía):

Average Treatment Effect on Treated

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

ATT | -.0417518 .0115028 -3.63 0.000 -.0642969 -.0192066

------------------------------------------------------------------------------

Efecto agregado por grupos (con variables explicativas y sin utilizar el grupo de los no tratados todavía):

ATT by group

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

GAverage | -.0310183 .0123872 -2.50 0.012 -.0552967 -.0067399

G2004 | -.0797491 .0263678 -3.02 0.002 -.1314291 -.0280692

G2006 | -.0229095 .0167033 -1.37 0.170 -.0556475 .0098284

G2007 | -.0260544 .0166554 -1.56 0.118 -.0586985 .0065896

------------------------------------------------------------------------------

Efecto agregado por período (con variables explicativas y sin utilizar el grupo de los no tratados todavía):

ATT by Calendar Period

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

CAverage | -.0441774 .0150382 -2.94 0.003 -.0736516 -.0147031

T2004 | -.0145297 .0221292 -0.66 0.511 -.057902 .0288427

T2005 | -.0764219 .0286713 -2.67 0.008 -.1326166 -.0202271

T2006 | -.0461757 .0212107 -2.18 0.029 -.087748 -.0046035

T2007 | -.0395822 .0129299 -3.06 0.002 -.0649242 -.0142401

------------------------------------------------------------------------------

Efecto agregado por períodos tras el otorgamiento del tratamiento (con variables explicativas y sin utilizar el grupo de los no tratados todavía):

ATT by Periods Before and After treatment

Event Study:Dynamic effects

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

Pre\_avg | -.0000442 .0075204 -0.01 0.995 -.014784 .0146955

Post\_avg | -.0803539 .0189576 -4.24 0.000 -.1175101 -.0431978

Tm3 | .0267278 .0140657 1.90 0.057 -.0008404 .054296

Tm2 | -.0036165 .0129283 -0.28 0.780 -.0289555 .0217226

Tm1 | -.023244 .0144851 -1.60 0.109 -.0516343 .0051463

Tp0 | -.0210604 .0114942 -1.83 0.067 -.0435886 .0014679

Tp1 | -.0530032 .0163465 -3.24 0.001 -.0850417 -.0209647

Tp2 | -.1404483 .0353782 -3.97 0.000 -.2097882 -.0711084

Tp3 | -.1069039 .0328865 -3.25 0.001 -.1713602 -.0424476

------------------------------------------------------------------------------

**(e)** *Hasta ahora, se utilizaron los nunca tratados como grupo de control. Repetir los incisos anteriores utilizando el grupo de los no tratados todavía. ¿Se observan cambios?*

Estimación (sin variables explicativas y utilizando el grupo de los no tratados todavía):

Difference-in-difference with Multiple Time Periods

Number of obs = 2,500

Outcome model : least squares

Treatment model: inverse probability

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

g2004 |

t\_2003\_2004 | -.0193724 .0223101 -0.87 0.385 -.0630994 .0243547

t\_2003\_2005 | -.0783191 .0303902 -2.58 0.010 -.1378829 -.0187553

t\_2003\_2006 | -.1362743 .0354034 -3.85 0.000 -.2056637 -.066885

t\_2003\_2007 | -.1008114 .0343592 -2.93 0.003 -.1681542 -.0334685

-------------+----------------------------------------------------------------

g2006 |

t\_2003\_2004 | -.0025626 .0225302 -0.11 0.909 -.046721 .0415959

t\_2004\_2005 | -.0019392 .0190422 -0.10 0.919 -.0392612 .0353827

t\_2005\_2006 | .0046609 .0163356 0.29 0.775 -.0273563 .036678

t\_2005\_2007 | -.0412245 .0202292 -2.04 0.042 -.0808729 -.001576

-------------+----------------------------------------------------------------

g2007 |

t\_2003\_2004 | .0305067 .0150336 2.03 0.042 .0010414 .0599719

t\_2004\_2005 | -.0027259 .0163958 -0.17 0.868 -.0348611 .0294093

t\_2005\_2006 | -.0310871 .0178775 -1.74 0.082 -.0661264 .0039522

t\_2006\_2007 | -.0260544 .0166554 -1.56 0.118 -.0586985 .0065896

------------------------------------------------------------------------------

Control: Not yet Treated

See Callaway and Sant'Anna (2021) for details

Test para tendencias paralelas (sin variables explicativas y utilizando el grupo de los no tratados todavía):

Pretrend Test. H0 All Pre-treatment are equal to 0

chi2(5) = 7.7912

p-value = 0.1681

Efecto agregado simple (sin variables explicativas y utilizando el grupo de los no tratados todavía):

Average Treatment Effect on Treated

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

ATT | -.0397636 .0120524 -3.30 0.001 -.0633859 -.0161413

------------------------------------------------------------------------------

Efecto agregado por grupos (sin variables explicativas y utilizando el grupo de los no tratados todavía):

ATT by group

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

GAverage | -.0304622 .0125031 -2.44 0.015 -.0549678 -.0059566

G2004 | -.0836943 .0257016 -3.26 0.001 -.1340685 -.0333201

G2006 | -.0182818 .0159222 -1.15 0.251 -.0494888 .0129252

G2007 | -.0260544 .0166554 -1.56 0.118 -.0586985 .0065896

------------------------------------------------------------------------------

Efecto agregado por período (sin variables explicativas y utilizando el grupo de los no tratados todavía):

ATT by Calendar Period

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

CAverage | -.0442671 .0155709 -2.84 0.004 -.0747855 -.0137487

T2004 | -.0193724 .0223101 -0.87 0.385 -.0630994 .0243547

T2005 | -.0783191 .0303902 -2.58 0.010 -.1378829 -.0187553

T2006 | -.0423175 .0190563 -2.22 0.026 -.0796671 -.004968

T2007 | -.0370593 .0137471 -2.70 0.007 -.0640031 -.0101156

------------------------------------------------------------------------------

Efecto agregado por períodos tras el otorgamiento del tratamiento (sin variables explicativas y utilizando el grupo de los no tratados todavía):

ATT by Periods Before and After treatment

Event Study:Dynamic effects

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

Pre\_avg | .0011834 .0073393 0.16 0.872 -.0132015 .0155682

Post\_avg | -.0773993 .0195602 -3.96 0.000 -.1157366 -.0390621

Tm3 | .0305067 .0150336 2.03 0.042 .0010414 .0599719

Tm2 | -.0026877 .0134388 -0.20 0.841 -.0290273 .0236519

Tm1 | -.0242689 .0144637 -1.68 0.093 -.0526172 .0040794

Tp0 | -.0189222 .0120446 -1.57 0.116 -.0425291 .0046847

Tp1 | -.0535893 .0169464 -3.16 0.002 -.0868037 -.020375

Tp2 | -.1362743 .0354034 -3.85 0.000 -.2056637 -.066885

Tp3 | -.1008114 .0343592 -2.93 0.003 -.1681542 -.0334685

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Estimación (con variables explicativas y utilizando el grupo de los no tratados todavía):

Difference-in-difference with Multiple Time Periods

Number of obs = 2,500

Outcome model : least squares

Treatment model: inverse probability

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

g2004 |

t\_2003\_2004 | -.0211831 .0216482 -0.98 0.328 -.0636128 .0212467

t\_2003\_2005 | -.0816032 .0283415 -2.88 0.004 -.1371516 -.0260548

t\_2003\_2006 | -.1381918 .034228 -4.04 0.000 -.2052775 -.0711061

t\_2003\_2007 | -.1069039 .0328865 -3.25 0.001 -.1713602 -.0424476

-------------+----------------------------------------------------------------

g2006 |

t\_2003\_2004 | -.0074552 .0218357 -0.34 0.733 -.0502525 .035342

t\_2004\_2005 | -.0045634 .0182914 -0.25 0.803 -.0404138 .0312871

t\_2005\_2006 | .0086607 .0168391 0.51 0.607 -.0243433 .0416647

t\_2005\_2007 | -.0412939 .0197211 -2.09 0.036 -.0799466 -.0026411

-------------+----------------------------------------------------------------

g2007 |

t\_2003\_2004 | .0267278 .0140657 1.90 0.057 -.0008404 .054296

t\_2004\_2005 | -.0045766 .0157178 -0.29 0.771 -.0353828 .0262297

t\_2005\_2006 | -.0284475 .0181809 -1.56 0.118 -.0640814 .0071864

t\_2006\_2007 | -.0287814 .016239 -1.77 0.076 -.0606091 .0030464

------------------------------------------------------------------------------

Control: Not yet Treated

See Callaway and Sant'Anna (2021) for details

Test para tendencias paralelas (con variables explicativas y utilizando el grupo de los no tratados todavía):

Pretrend Test. H0 All Pre-treatment are equal to 0

chi2(5) = 6.8655

p-value = 0.2308

Efecto agregado simple (con variables explicativas y utilizando el grupo de los no tratados todavía):

Average Treatment Effect on Treated

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

ATT | -.0413516 .0114278 -3.62 0.000 -.0637498 -.0189535

------------------------------------------------------------------------------

Efecto agregado por grupos (con variables explicativas y utilizando el grupo de los no tratados todavía):

ATT by group

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

GAverage | -.032264 .0119004 -2.71 0.007 -.0555884 -.0089397

G2004 | -.0869705 .024062 -3.61 0.000 -.1341312 -.0398097

G2006 | -.0163166 .0161883 -1.01 0.313 -.0480451 .015412

G2007 | -.0287814 .016239 -1.77 0.076 -.0606091 .0030464

------------------------------------------------------------------------------

Efecto agregado por período (con variables explicativas y utilizando el grupo de los no tratados todavía):

ATT by Calendar Period

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

CAverage | -.0456646 .0146983 -3.11 0.002 -.0744727 -.0168566

T2004 | -.0211831 .0216482 -0.98 0.328 -.0636128 .0212467

T2005 | -.0816032 .0283415 -2.88 0.004 -.1371516 -.0260548

T2006 | -.0402901 .0192635 -2.09 0.036 -.0780459 -.0025344

T2007 | -.0395822 .0129299 -3.06 0.002 -.0649242 -.0142401

------------------------------------------------------------------------------

Efecto agregado por períodos tras el otorgamiento del tratamiento (con variables explicativas y utilizando el grupo de los no tratados todavía):

ATT by Periods Before and After treatment

Event Study:Dynamic effects

------------------------------------------------------------------------------

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

-------------+----------------------------------------------------------------

Pre\_avg | -.0004609 .0072816 -0.06 0.950 -.0147326 .0138108

Post\_avg | -.0799926 .018494 -4.33 0.000 -.1162402 -.043745

Tm3 | .0267278 .0140657 1.90 0.057 -.0008404 .054296

Tm2 | -.0052499 .0130015 -0.40 0.686 -.0307325 .0202326

Tm1 | -.0228606 .0146118 -1.56 0.118 -.0514991 .005778

Tp0 | -.0201445 .0116323 -1.73 0.083 -.0429433 .0026544

Tp1 | -.0547303 .0164 -3.34 0.001 -.0868738 -.0225869

Tp2 | -.1381918 .034228 -4.04 0.000 -.2052775 -.0711061

Tp3 | -.1069039 .0328865 -3.25 0.001 -.1713602 -.0424476

------------------------------------------------------------------------------

**(f)** *Comparar con los resultados que surgen de hacer TWFE estático y dinámico.*

TWFE estático:

HDFE Linear regression Number of obs = 2,500

Absorbing 2 HDFE groups F( 1, 499) = 7.59

Statistics robust to heteroskedasticity Prob > F = 0.0061

R-squared = 0.9932

Adj R-squared = 0.9915

Within R-sq. = 0.0042

Number of clusters (countyreal) = 500 Root MSE = 0.1391

(Std. err. adjusted for 500 clusters in countyreal)

------------------------------------------------------------------------------

| Robust

lemp | Coefficient std. err. t P>|t| [95% conf. interval]

-------------+----------------------------------------------------------------

D | -.0365489 .0132652 -2.76 0.006 -.0626114 -.0104865

\_cons | 5.776771 .0015441 3741.28 0.000 5.773737 5.779804

------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

countyreal | 500 500 0 \*|

year | 5 1 4 |

-----------------------------------------------------+

\* = FE nested within cluster; treated as redundant for DoF computation

TWFE dinámico:

HDFE Linear regression Number of obs = 2,500

Absorbing 2 HDFE groups F( 7, 499) = 3.60

Statistics robust to heteroskedasticity Prob > F = 0.0009

R-squared = 0.9933

Adj R-squared = 0.9915

Within R-sq. = 0.0103

Number of clusters (countyreal) = 500 Root MSE = 0.1388

(Std. err. adjusted for 500 clusters in countyreal)

------------------------------------------------------------------------------

| Robust

lemp | Coefficient std. err. t P>|t| [95% conf. interval]

-------------+----------------------------------------------------------------

Tm4 | .0216933 .0253871 0.85 0.393 -.0281855 .071572

Tm3 | .0427674 .0199126 2.15 0.032 .0036446 .0818902

Tm2 | .0414987 .0162692 2.55 0.011 .0095342 .0734633

Tm1 | .0181439 .0109822 1.65 0.099 -.0034332 .039721

Tp1 | -.0253284 .0160191 -1.58 0.114 -.0568016 .0061447

Tp2 | -.1136509 .0270505 -4.20 0.000 -.1667978 -.060504

Tp3 | -.0741029 .031016 -2.39 0.017 -.1350409 -.0131648

\_cons | 5.76634 .0040209 1434.09 0.000 5.75844 5.77424

------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

countyreal | 500 500 0 \*|

year | 5 1 4 |

-----------------------------------------------------+

\* = FE nested within cluster; treated as redundant for DoF computation

**Ejercicio 4: Enfoque de Wooldridge y jwdid.**

*Frente a las críticas de la literatura a la presunta incapacidad de la especificación de TWFE para estimar los efectos promedio de tratamiento sobre los tratados, Wooldridge (2021) propone que el problema no es intrínseco a que la ecuación de estimación sea lineal con efectos fijos ni a que se estime con los métodos tradicionales de datos de panel.1 En particular, con T períodos temporales y el tratamiento otorgado en cada período desde el período q hasta el último, se propone estimar la siguiente ecuación:*

*= + + … + + + + ,*

*donde representa el ATT en el período s para el grupo r, es una constante, es una dummy que vale 1 para el grupo tratado en r, con r= q, … , T. Replicar el ejercicio anterior con el comando jwdid.*

Estimación (sin variables explicativas y sin utilizar el grupo de los no tratados todavía):

HDFE Linear regression Number of obs = 2,500

Absorbing 2 HDFE groups F( 12, 499) = 2.87

Statistics robust to heteroskedasticity Prob > F = 0.0008

R-squared = 0.0288

Adj R-squared = 0.0213

Within R-sq. = 0.0001

Number of clusters (countyreal) = 500 Root MSE = 1.4926

(Std. err. adjusted for 500 clusters in countyreal)

-------------------------------------------------------------------------------------------

| Robust

lemp | Coefficient std. err. t P>|t| [95% conf. interval]

--------------------------+----------------------------------------------------------------

first\_treat#year#c.\_\_tr\_\_ |

2004 2004 | -.0105032 .0233633 -0.45 0.653 -.0564058 .0353993

2004 2005 | -.0704232 .0311344 -2.26 0.024 -.1315938 -.0092525

2004 2006 | -.1372587 .0366116 -3.75 0.000 -.2091906 -.0653269

2004 2007 | -.1008114 .0345251 -2.92 0.004 -.1686439 -.0329788

2006 2003 | -.0037693 .0314934 -0.12 0.905 -.0656452 .0581067

2006 2004 | .0027508 .019653 0.14 0.889 -.035862 .0413637

2006 2006 | -.0045946 .0178409 -0.26 0.797 -.0396472 .030458

2006 2007 | -.0412245 .0203269 -2.03 0.043 -.0811613 -.0012877

2007 2003 | .0033064 .0245699 0.13 0.893 -.0449669 .0515796

2007 2004 | .033813 .0212312 1.59 0.112 -.0079006 .0755266

2007 2005 | .0310871 .0179638 1.73 0.084 -.004207 .0663812

2007 2007 | -.0260544 .0167359 -1.56 0.120 -.0589358 .006827

|

\_cons | 5.773609 .0666494 86.63 0.000 5.642661 5.904557

-------------------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

first\_treat | 4 0 4 |

year | 5 1 4 |

-----------------------------------------------------+

Estimación (con variables explicativas y sin utilizar el grupo de los no tratados todavía):

HDFE Linear regression Number of obs = 2,500

Absorbing 2 HDFE groups F( 32, 499) = 260.29

Statistics robust to heteroskedasticity Prob > F = 0.0000

R-squared = 0.8732

Adj R-squared = 0.8712

Within R-sq. = 0.8695

Number of clusters (countyreal) = 500 Root MSE = 0.5414

(Std. err. adjusted for 500 clusters in countyreal)

-----------------------------------------------------------------------------------------------------

| Robust

lemp | Coefficient std. err. t P>|t| [95% conf. interval]

------------------------------------+----------------------------------------------------------------

first\_treat#year#c.\_\_tr\_\_ |

2004 2004 | -.0149112 .0222514 -0.67 0.503 -.0586293 .0288068

2004 2005 | -.0769963 .0278076 -2.77 0.006 -.1316307 -.022362

2004 2006 | -.1410801 .0322892 -4.37 0.000 -.2045196 -.0776406

2004 2007 | -.1075443 .0329232 -3.27 0.001 -.1722294 -.0428592

2006 2003 | .0090343 .0302653 0.30 0.765 -.0504289 .0684976

2006 2004 | .0069683 .0182179 0.38 0.702 -.028825 .0427616

2006 2006 | .0007655 .0186594 0.04 0.967 -.0358952 .0374263

2006 2007 | -.0415356 .0192255 -2.16 0.031 -.0793085 -.0037627

2007 2003 | .0068961 .0246894 0.28 0.780 -.0416118 .055404

2007 2004 | .0332619 .021331 1.56 0.120 -.0086478 .0751717

2007 2005 | .0285021 .0182913 1.56 0.120 -.0074353 .0644395

2007 2007 | -.0287895 .0161542 -1.78 0.075 -.0605281 .0029491

|

first\_treat#year#c.\_\_tr\_\_#c.\_x\_lpop |

2004 2004 | .0005953 .0183817 0.03 0.974 -.0355198 .0367104

2004 2005 | .0234096 .018401 1.27 0.204 -.0127434 .0595626

2004 2006 | .0482261 .0224513 2.15 0.032 .0041154 .0923369

2004 2007 | .0091886 .0271808 0.34 0.735 -.0442144 .0625916

2006 2003 | -.0126074 .0243681 -0.52 0.605 -.0604842 .0352693

2006 2004 | -.0177865 .0162122 -1.10 0.273 -.0496391 .0140661

2006 2006 | .0282074 .0141414 1.99 0.047 .0004234 .0559915

2006 2007 | .0277793 .0181101 1.53 0.126 -.0078021 .0633607

2007 2003 | .0083787 .0254399 0.33 0.742 -.0416037 .0583611

2007 2004 | -.0079105 .0188942 -0.42 0.676 -.0450324 .0292114

2007 2005 | -.0025825 .0178553 -0.14 0.885 -.0376633 .0324982

2007 2007 | -.0203637 .0162347 -1.25 0.210 -.0522606 .0115331

|

lpop | 1.0634 .0212754 49.98 0.000 1.0216 1.1052

|

first\_treat#c.lpop |

2004 | .0530435 .0374929 1.41 0.158 -.02062 .126707

2006 | -.030815 .0461109 -0.67 0.504 -.1214104 .0597803

2007 | .056047 .0439926 1.27 0.203 -.0303866 .1424806

|

year#c.lpop |

2004 | .0150462 .0092116 1.63 0.103 -.0030521 .0331445

2005 | .0224368 .0091008 2.47 0.014 .0045562 .0403173

2006 | .0130438 .0132642 0.98 0.326 -.0130168 .0391044

2007 | .0229821 .0129513 1.77 0.077 -.0024638 .0484279

|

\_cons | 2.152986 .0722075 29.82 0.000 2.011117 2.294854

-----------------------------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

first\_treat | 4 0 4 |

year | 5 1 4 |

-----------------------------------------------------+

Estimación (sin variables explicativas y utilizando el grupo de los no tratados todavía):

HDFE Linear regression Number of obs = 2,500

Absorbing 2 HDFE groups F( 7, 499) = 3.81

Statistics robust to heteroskedasticity Prob > F = 0.0005

R-squared = 0.0288

Adj R-squared = 0.0233

Within R-sq. = 0.0001

Number of clusters (countyreal) = 500 Root MSE = 1.4911

(Std. err. adjusted for 500 clusters in countyreal)

-------------------------------------------------------------------------------------------

| Robust

lemp | Coefficient std. err. t P>|t| [95% conf. interval]

--------------------------+----------------------------------------------------------------

first\_treat#year#c.\_\_tr\_\_ |

2004 2004 | -.0193724 .0223953 -0.87 0.387 -.063373 .0246283

2004 2005 | -.0783191 .0305062 -2.57 0.011 -.1382556 -.0183826

2004 2006 | -.1360781 .0354769 -3.84 0.000 -.2057806 -.0663756

2004 2007 | -.1047075 .0338947 -3.09 0.002 -.1713015 -.0381135

2006 2006 | .0025139 .0199448 0.13 0.900 -.0366724 .0417001

2006 2007 | -.0391927 .0240232 -1.63 0.103 -.0863919 .0080064

2007 2007 | -.043106 .0184423 -2.34 0.020 -.0793401 -.006872

|

\_cons | 5.77807 .0665051 86.88 0.000 5.647405 5.908734

-------------------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

first\_treat | 4 0 4 |

year | 5 1 4 |

-----------------------------------------------------+

Estimación (con variables explicativas y utilizando el grupo de los no tratados todavía):

HDFE Linear regression Number of obs = 2,500

Absorbing 2 HDFE groups F( 22, 499) = 364.06

Statistics robust to heteroskedasticity Prob > F = 0.0000

R-squared = 0.8732

Adj R-squared = 0.8717

Within R-sq. = 0.8695

Number of clusters (countyreal) = 500 Root MSE = 0.5404

(Std. err. adjusted for 500 clusters in countyreal)

-----------------------------------------------------------------------------------------------------

| Robust

lemp | Coefficient std. err. t P>|t| [95% conf. interval]

------------------------------------+----------------------------------------------------------------

first\_treat#year#c.\_\_tr\_\_ |

2004 2004 | -.021248 .021724 -0.98 0.329 -.0639298 .0214338

2004 2005 | -.08185 .0273694 -2.99 0.003 -.1356234 -.0280766

2004 2006 | -.1378704 .0307884 -4.48 0.000 -.1983612 -.0773796

2004 2007 | -.1095395 .0323153 -3.39 0.001 -.1730302 -.0460487

2006 2006 | .0025368 .018879 0.13 0.893 -.0345554 .039629

2006 2007 | -.0450935 .0219826 -2.05 0.041 -.0882834 -.0019035

2007 2007 | -.0459545 .0179714 -2.56 0.011 -.0812636 -.0106455

|

first\_treat#year#c.\_\_tr\_\_#c.\_x\_lpop |

2004 2004 | .0046278 .0175804 0.26 0.792 -.0299129 .0391685

2004 2005 | .0251131 .0179003 1.40 0.161 -.0100561 .0602822

2004 2006 | .0507346 .0210659 2.41 0.016 .0093457 .0921234

2004 2007 | .0112497 .0266118 0.42 0.673 -.0410353 .0635346

2006 2006 | .0389352 .0164686 2.36 0.018 .0065789 .0712915

2006 2007 | .0380597 .0224724 1.69 0.091 -.0060925 .082212

2007 2007 | -.0198351 .0161949 -1.22 0.221 -.0516538 .0119835

|

lpop | 1.065461 .0218238 48.82 0.000 1.022583 1.108339

|

first\_treat#c.lpop |

2004 | .0509824 .0377558 1.35 0.178 -.0231975 .1251622

2006 | -.0410954 .0473896 -0.87 0.386 -.1342031 .0520122

2007 | .0555184 .0392124 1.42 0.157 -.0215233 .1325601

|

year#c.lpop |

2004 | .0110137 .0075537 1.46 0.145 -.0038274 .0258548

2005 | .0207333 .0081044 2.56 0.011 .0048103 .0366564

2006 | .0105354 .0108157 0.97 0.330 -.0107145 .0317853

2007 | .020921 .0118084 1.77 0.077 -.0022793 .0441212

|

\_cons | 2.1617 .0699859 30.89 0.000 2.024197 2.299204

-----------------------------------------------------------------------------------------------------

Absorbed degrees of freedom:

-----------------------------------------------------+

Absorbed FE | Categories - Redundant = Num. Coefs |

-------------+---------------------------------------|

first\_treat | 4 0 4 |

year | 5 1 4 |

-----------------------------------------------------+