Apéndice B. Desarrollo asintótico

Se detalla la metodología empleada para obtener los resultados asintóticos: Sea la especificación 4, misma que se estima suponiendo que las variables se generan con base en el **PGD A**. La estimación de los parámetros $\hat{\alpha}, \hat{\beta}$ y $\hat{\delta}$ se hizo mediante la formulación matricial de MCO:[1]

$$Y = X\beta + U$$

donde:

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \vdots \\ y_T \end{bmatrix} \; X = \begin{bmatrix} 1 & x_1 & y_0 \\ 1 & x_2 & y_1 \\ 1 & x_3 & y_2 \\ \vdots & \vdots & \vdots \\ 1 & x_T & y_{T-1} \end{bmatrix} \; \beta = \begin{bmatrix} \hat{\alpha} \\ \hat{\beta} \\ \hat{\delta} \end{bmatrix} \; U = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ \vdots \\ \epsilon_T \end{bmatrix}$$

Se calculan los estimadores de MCO mediante la fórmula clásica $\hat{\beta} = (X'X)^{-1} X'Y$. Si desarrollamos la matriz cuadrada $X'X$ obtenemos:

$$X'X = \begin{vmatrix} T & \sum x_t & \sum y_{t-1} \\ \sum x_t & \sum x_t^2 & \sum x_t y_{t-1} \\ \sum y_{t-1} & \sum x_t y_{t-1} & \sum y_t^2 \end{vmatrix}$$

Por otra parte, al desarrollar $X'Y$ obtenemos:

$$X'Y = \begin{bmatrix} \sum y_t \\ \sum x_t y_t \\ \sum y_t y_{t-1} \end{bmatrix}$$

[1] Todas las sumas son hasta *T*.

Desarrollamos posteriormente cada una de las sumatorias que aparecen en estas matrices (se coloca bajo cada componente de la sumatoria el orden de divergencia que le corresponde). Dado que x_t y y_t tienen el mismo PGD, las sumatorias (i) $\sum y_t, \sum x_t$; (ii) $\sum y_t^2, \sum x_t^2$ (iii) $\sum y_{t-1}^2 \sum x_{t-1}^2$; (iv) $\sum y_t y_{t-1}, \sum x_t x_{t-1}$ son esencialmente iguales (sólo cambia el subíndice de los parámetros), las desarrollamos usando la notación *z*= *x*,*y*. Todos los órdenes de convergencia pueden encontrarse en Phillips (1986), o en Hamilton (1994):

$$\sum z_t = \mu_z T + \underbrace{\beta_z \sum t}_{O_p(T^2)} + \underbrace{\sum u_{zt}}_{O_p(T^{1/2})}$$

$$\sum z_{t-1} = \mu_z T + \beta_z \sum t - \beta_z T + \underbrace{\sum u_{zt-1}}_{O_p(T^{1/2})}$$

$$\sum z_t^2 = \mu_z^2 T + \underbrace{\beta_z^2 \sum t^2}_{O_p(T^3)} + \underbrace{\sum u_{zt}^2}_{O_p(T)} + 2\mu_z \beta_z \sum t + 2\mu_z \sum u_{zt} + \underbrace{2\beta_z \sum u_{zt} t}_{O_p(T^{3/2})}$$

$$\sum z_t z_{t-1} = \mu_z^2 T + 2\mu_z \beta_z \sum t - \mu_z \beta_z T + \mu_z \sum u_{zt} + \mu_z \sum u_{zt-1}$$

$$+ \beta_z^2 \sum t^2 - \beta_z^2 \sum t + \beta_z \sum u_{zt} t + \beta_z \sum u_{zt-1} t$$

$$- \beta_z \sum u_{zt} + \underbrace{\sum u_{zt} u_{zt-1}}_{O_p(T^{1/2})}$$

En los restantes desarrollos es necesario distinguir *x de y*:

$$\begin{aligned}\sum x_t y_t &= \mu_y\mu_x T + \mu_y\beta_x\sum t + \mu_y\sum u_{xt} + \mu_x\beta_y\sum t\\ &+\beta_x\beta_y\sum t^2 + \beta_y\sum u_{xt}t + \mu_x\sum u_{yt}\\ &+\beta_x\sum u_{yt}t + \underbrace{\sum u_{yt}u_{xt}}_{Op(T^{1/2})}\\ \sum x_t y_{t-1} &= \mu_y\mu_x T + \mu_x\beta_y\sum t - \mu_x\beta_y T + \mu_x\sum u_{yt-1} + \mu_y\beta_x\sum t\\ &+\beta_x\beta_y\sum t^2 - \beta_x\beta_y\sum t + \beta_x\sum u_{yt-1}t + \mu_y\sum u_{xt}\\ &+\beta_y\sum u_{xt}t - \beta_y\sum u_{xt} + \underbrace{\sum u_{yt-1}u_{xt}}_{Op(T^{1/2})}\end{aligned}$$

Finalmente, sólo resta precisar las sumas deterministas:

$$\begin{aligned}\sum t &= \frac{1}{2}\left(T^2+T\right)\\ \sum t^2 &= \frac{1}{6}\left(2T^3+3T^2+T\right)\end{aligned}$$

Apéndice C. Cálculo asintótico en *Mathematica*^{TM}

Las expresiones anteriormente desarrolladas se capturan en un programa que realiza todo el cálculo asintótico necesario. En este apartado, se presenta el código realizado en *Mathematica 4.1* para obtener el valor asintótico de los estimadores $\hat{\alpha}, \hat{\beta}$ y $\hat{\delta}$, así como de $\hat{\sigma}^2$ y de la R^2.[2] Para poder leer dicho código es necesario conocer el glosario; éste se divide en dos. El primer glosario [ver cuadro (3)] es el que permite leer los programas relativos a la estimación de los parámetros, la varianza y la bondad de ajuste. El segundo glosario [ver cuadro (4)] permite leer los programas relativos al cálculo del estadístico *DW*:

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[2] El estadístico F puede derivarse fácilmente con base en su relación con la R^2.

C.1. Glosarios

Letra(s)	Representa	Letra(s)	Representa
Mz	μ_z	St	$\sum t$
Bz	β_z	$St2$	$\sum t^2$
Uz	$\sum u_{zt}$	Uzt	$\sum u_{zt} t$
$Uy1$	$\sum u_{yt-1}$	$Uy1t$	$\sum u_{yt-1} t$
Uzc	$\sum u_{zt}^2$	C	$\sum u_{yt} u_{yt-1}$
$Uy1c$	$\sum u_{yt-1}^2$	D	$\sum u_{xt} u_{yt}$
F	$\sum u_{xt} u_{yt-1}$	Sz	$\sum z_t$
$Sy1$	$\sum y_{t-1}$	$Sz2$	$\sum z_t^2$
$Sy12$	$\sum y_{t-1}^2$	$Syy1$	$\sum y_t y_{t-1}$
Sxy	$\sum y_t x_t$	$Sxy1$	$\sum x_t y_{t-1}$

Cuadro 3: Glosario para demostración de resultados asintóticos relativos a $\hat{\alpha}, \hat{\beta}$ y $\hat{\delta}, \hat{\sigma}^2$ y R^2. $z = x, y$. Note que $\sum u_{yt} u_{yt-1} = O_p(T^{1/2})$ en ausencia de autocorrelación y $O_p(T)$ en presencia de ésta.

Letra(s)	Representa	Letra(s)	Representa
Sz	σ_z^2	$Sz1$	σ_z^2
$Sdz2$	$\sum \Delta^2 z_t$	$Sdy12$	$\sum \Delta^2 y_{t-1}$
$Sdydx$	$\sum \Delta y_t \Delta x_t$	$Sdydy1$	$\sum \Delta y_t \Delta y_{t-1}$
$Sdy1dx$	$\sum \Delta y_{t-1} \Delta x_t$	Be	$plim\left(\hat{\beta}\right)$
De	$plim\left(\hat{\delta}\right)$	Pru	Num. de $\mathcal{DW}$

Cuadro 4: Glosario para demostración de resultados asintóticos relativos al numerador del estadístico *DW*(el denominador es asintóticamente $\hat{\sigma}^2 T \;\; z = x, y$).

C.2. Demostración del teorema 1

C.2.1. Estimación de los parámetros, la varianza y la bondad de ajuste

$\text{ClearAll}; \text{St} = \frac{1}{2} * (T^2 + T); \text{St2} = \frac{1}{6} * (2 * T^3 + 3 * T^2 + T);$

$\text{Sy} = \text{My} * T + \text{By} * \text{St} + \text{Uy} * T^{\frac{1}{2}};$
$\text{Sx} = \text{Mx} * T + \text{Bx} * \text{St} + \text{Ux} * T^{\frac{1}{2}};$
$\text{Sy1} = \text{My} * T + \text{By} * \text{St} - \text{By} * T + \text{Uy1} * T^{\frac{1}{2}};$
$\text{Sy2} = \text{My}^2 * T + \text{By}^2 * \text{St2} + \text{Uyc} * T + 2 * \text{My} * \text{By} * \text{St} + 2 * \text{My} * \text{Uy} * T^{\frac{1}{2}}$
$+2 * \text{By} * \text{Uyt} * T^{\frac{3}{2}};$
$\text{Sx2} = \text{Mx}^2 * T + \text{Bx}^2 * \text{St2} + \text{Uxc} * T + 2 * \text{Mx} * \text{Bx} * \text{St} + 2 * \text{Mx} * \text{Ux} * T^{\frac{1}{2}}$
$+2 * \text{Bx} * \text{Uxt} * T^{\frac{3}{2}};$
$\text{Sy12} = \text{My}^2 * T + \text{By}^2 * \text{St2} + \text{By}^2 * T + \text{Uy1c} * T + 2 * \text{My} * \text{By} * \text{St}$
$-2 * \text{My} * \text{By} * T + 2 * \text{My} * \text{Uy1} * T^{\frac{1}{2}} - 2 * \text{By}^2 * \text{St} + 2 * \text{By} * \text{Uy1t} * T^{\frac{3}{2}}$
$-2 * \text{By} * \text{Uy1} * T^{\frac{1}{2}};$
$\text{Syy1} = \text{My}^2 * T + 2 * \text{My} * \text{By} * \text{St} - \text{My} * \text{By} * T + \text{My} * \text{Uy1} * T^{\frac{1}{2}}$
$+\text{By}^2 * \text{St2} - \text{By}^2 * \text{St} + \text{By} * \text{Uy1t} * T^{\frac{3}{2}} + \text{My} * \text{Uy} * T^{\frac{1}{2}} + \text{By} * \text{Uyt} * T^{\frac{3}{2}}$
$-\text{By} * \text{Uy} * T^{\frac{1}{2}} + C * T^{\frac{1}{2}};$

$$\mathrm{Sxy} = \mathrm{Mx} * \mathrm{My} * T + \mathrm{Mx} * \mathrm{By} * \mathrm{St} + \mathrm{Mx} * \mathrm{Uy} * T^{\frac{1}{2}} + \mathrm{My} * \mathrm{Bx} * \mathrm{St}$$
$$+\mathrm{Bx} * \mathrm{By} * \mathrm{St2} + \mathrm{Bx} * \mathrm{Uyt} * T^{\frac{3}{2}} + \mathrm{My} * \mathrm{Ux} * T^{\frac{1}{2}} + \mathrm{By} * \mathrm{Uxt} * T^{\frac{3}{2}}$$
$$+D * T^{\frac{1}{2}};$$
$$\mathrm{Sxy1} = \mathrm{Mx} * \mathrm{My} * T + \mathrm{Mx} * \mathrm{By} * \mathrm{St} - \mathrm{Mx} * \mathrm{By} * T + \mathrm{Mx} * \mathrm{Uy1} * T^{\frac{1}{2}}$$
$$+\mathrm{My} * \mathrm{Bx} * \mathrm{St} + \mathrm{Bx} * \mathrm{By} * \mathrm{St2} - \mathrm{Bx} * \mathrm{By} * \mathrm{St} + \mathrm{Bx} * \mathrm{Uy1t} * T^{\frac{3}{2}}$$
$$+\mathrm{My} * \mathrm{Ux} * T^{\frac{1}{2}} + \mathrm{By} * \mathrm{Uxt} * T^{\frac{3}{2}} - \mathrm{By} * \mathrm{Ux} * T^{\frac{1}{2}} + F * T^{\frac{1}{2}};$$

$$\mathrm{MxNR} = ((\begin{matrix} T & \mathrm{Sx} & \mathrm{Sy1} \\ \mathrm{Sx} & \mathrm{Sx2} & \mathrm{Sxy1} \\ \mathrm{Sy1} & \mathrm{Sxy1} & \mathrm{Sy12} \end{matrix})); \mathrm{XTY} = (\begin{matrix} \mathrm{Sy} \\ \mathrm{Sxy} \\ \mathrm{Syy1} \end{matrix});$$
$$\mathrm{iMxNR} = \mathrm{Inverse}[\mathrm{MxNR}];$$

$$\mathrm{R1} = \mathrm{Extract}[\mathrm{iMxNR}, \{1, 1\}];$$
$$\mathrm{R10} = \mathrm{Factor}[\mathrm{R1}];$$
$$\mathrm{R1num} = \mathrm{Numerator}[\mathrm{R10}];$$
$$\mathrm{R1den} = \mathrm{Denominator}[\mathrm{R10}];$$
$$\mathrm{J5} = \mathrm{Exponent}[\mathrm{R1num}, T];$$
$$\mathrm{J6} = \mathrm{Exponent}[\mathrm{R1den}, T];$$
$$\mathrm{R1num2} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{R1num}/T^{\mathrm{J5}}], T \to \infty];$$
$$\mathrm{R1den2} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{R1den}/T^{\mathrm{J6}}], T \to \infty];$$
$$\mathrm{R12} = \mathrm{Factor}[\mathrm{Expand}[(\mathrm{R1num2}/\mathrm{R1den2}) * \tfrac{T^{\mathrm{J5}}}{T^{\mathrm{J6}}}]]$$
$$\mathrm{R2} = \mathrm{Extract}[\mathrm{iMxNR}, \{1, 2\}]; \mathrm{R3} = \mathrm{Extract}[\mathrm{iMxNR}, \{1, 3\}];$$
$$\mathrm{R4} = \mathrm{Extract}[\mathrm{iMxNR}, \{2, 1\}]; \mathrm{R5} = \mathrm{Extract}[\mathrm{iMxNR}, \{2, 2\}];$$
$$\mathrm{R50} = \mathrm{Factor}[\mathrm{R5}];$$

$\mathrm{R5num} = \mathrm{Numerator}[\mathrm{R50}];$
$\mathrm{R5den} = \mathrm{Denominator}[\mathrm{R50}];$
$\mathrm{J1} = \mathrm{Exponent}[\mathrm{R5num}, T];$
$\mathrm{J2} = \mathrm{Exponent}[\mathrm{R5den}, T];$
$\mathrm{R5num2} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{R5num}/T^{\mathrm{J1}}], T \to \infty];$
$\mathrm{R5den2} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{R5den}/T^{\mathrm{J2}}], T \to \infty];$
$\mathrm{R52} = \mathrm{Factor}[\mathrm{Expand}[(\mathrm{R5num2}/\mathrm{R5den2}) * \frac{T^{\mathrm{J1}}}{T^{\mathrm{J2}}}]]$
$\mathrm{R6} = \mathrm{Extract}[\mathrm{iMxNR}, \{2, 3\}]; \mathrm{R7} = \mathrm{Extract}[\mathrm{iMxNR}, \{3, 1\}];$
$\mathrm{R8} = \mathrm{Extract}[\mathrm{iMxNR}, \{3, 2\}]; \mathrm{R9} = \mathrm{Extract}[\mathrm{iMxNR}, \{3, 3\}];$

$\mathrm{R90} = \mathrm{Factor}[\mathrm{R9}];$
$\mathrm{R9num} = \mathrm{Numerator}[\mathrm{R90}];$
$\mathrm{R9den} = \mathrm{Denominator}[\mathrm{R90}];$
$\mathrm{J3} = \mathrm{Exponent}[\mathrm{R9num}, T];$
$\mathrm{J4} = \mathrm{Exponent}[\mathrm{R9den}, T];$
$\mathrm{R9num2} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{R9num}/T^{\mathrm{J3}}], T \to \infty];$
$\mathrm{R9den2} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{R9den}/T^{\mathrm{J4}}], T \to \infty];$

$\mathrm{R92} = \mathrm{Factor}[\mathrm{Expand}[(\mathrm{R9num2}/\mathrm{R9den2}) * \frac{T^{\mathrm{J3}}}{T^{\mathrm{J4}}}]]$

$\mathrm{Param1} = \mathrm{iMxNR.XTY};$

$\mathrm{P10} = \mathrm{Factor}[\mathrm{Expand}[\mathrm{Extract}[\mathrm{Param1}, \{1, 1\}]]];$
$\mathrm{P11num} = \mathrm{Numerator}[\mathrm{P10}];$
$\mathrm{K1} = \mathrm{Exponent}[\mathrm{P11num}, T];$
$\mathrm{Anum} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{P11num}/T^{\mathrm{K1}}], T \to \infty];$
$\mathrm{P12den} = \mathrm{Denominator}[\mathrm{P10}];$
$\mathrm{K2} = \mathrm{Exponent}[\mathrm{P12den}, T];$
$\mathrm{Aden} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{P12den}/T^{\mathrm{K2}}], T \to \infty];$

$$\text{Apar} = \text{Factor}[\text{Expand}[(\text{Anum}/\text{Aden}) * \frac{T^{\text{K1}}}{T^{\text{K2}}}]]$$

$$\begin{aligned}
&\text{P20} = \text{Factor}[\text{Expand}[\text{Extract}[\text{Param1}, \{2, 1\}]]];\\
&\text{P21num} = \text{Numerator}[\text{P20}];\\
&\text{K3} = \text{Exponent}[\text{P21num}, T];\\
&\text{Bnum} = \text{Limit}[\text{Expand}[\text{P21num}/T^{\text{K3}}], T \to \infty];\\
&\text{P22den} = \text{Denominator}[\text{P20}];\\
&\text{K4} = \text{Exponent}[\text{P22den}, T];\\
&\text{Bden} = \text{Limit}[\text{Expand}[\text{P22den}/T^{\text{K4}}], T \to \infty];\\
&\text{Bpar} = \text{Factor}[\text{Expand}[(\text{Bnum}/\text{Bden}) * \tfrac{T^{\text{K3}}}{T^{\text{K4}}}]]
\end{aligned}$$

$$\begin{aligned}
&\text{P30} = \text{Factor}[\text{Expand}[\text{Extract}[\text{Param1}, \{3, 1\}]]];\\
&\text{P31num} = \text{Numerator}[\text{P30}];\\
&\text{K5} = \text{Exponent}[\text{P31num}, T];\\
&\text{Dnum} = \text{Limit}[\text{Expand}[\text{P31num}/T^{\text{K5}}], T \to \infty];\\
&\text{P32den} = \text{Denominator}[\text{P30}];\\
&\text{K6} = \text{Exponent}[\text{P32den}, T];\\
&\text{Dden} = \text{Limit}[\text{Expand}[\text{P32den}/T^{\text{K6}}], T \to \infty];\\
&\text{Dpar} = \text{Factor}[\text{Expand}[(\text{Dnum}/\text{Dden}) * \tfrac{T^{\text{K5}}}{T^{\text{K6}}}]]
\end{aligned}$$

$$\begin{aligned}
&\text{P40} =\\
&\text{Factor}[\text{Expand}[\text{Sy2} + \text{Apar}^2 * T + \text{Bpar}^2 * \text{Sx2} + \text{Dpar}^2 * \text{Sy12} - 2 * \text{Apar} * \text{Sy}-\\
&2 * \text{Bpar} * \text{Sxy} - 2 * \text{Dpar} * \text{Syy1} + 2 * \text{Apar} * \text{Bpar} * \text{Sx} + 2 * \text{Apar} * \text{Dpar} * \text{Sy1}+\\
&2 * \text{Bpar} * \text{Dpar} * \text{Sxy1}]];\\
&\text{P41num} = \text{Numerator}[\text{P40}];\\
&\text{K7} = \text{Exponent}[\text{P41num}, T];\\
&\text{Wnum} = \text{Factor}[\text{Limit}[\text{Expand}[\text{P41num}/T^{\text{K7}}], T \to \infty]];\\
&\text{P42den} = \text{Denominator}[\text{P40}];\\
&\text{K8} = \text{Exponent}[\text{P42den}, T];\\
&\text{Wden} = \text{Factor}[\text{Limit}[\text{Expand}[\text{P42den}/T^{\text{K8}}], T \to \infty]];\\
&\text{Wpar} = \text{Factor}[\text{Expand}[T^{-1} * (\text{Wnum}/\text{Wden}) * \tfrac{T^{\text{K7}}}{T^{\text{K8}}}]]
\end{aligned}$$

$$\begin{aligned}
&\text{P50} = \text{Factor}[\text{Expand}[\text{P40}/(\text{Sy2} - (\tfrac{\text{Sy}*\text{Sy}}{T}))]];\\
&\text{P51num} = \text{Numerator}[\text{P50}];
\end{aligned}$$

$$\mathbf{P50} = \mathbf{Factor}[\mathbf{Expand}[\mathbf{P40}/(\mathbf{Sy2} - (\tfrac{\mathbf{Sy*Sy}}{T}))]];$$
$$\mathbf{P51num} = \mathbf{Numerator}[\mathbf{P50}];$$
$$\mathbf{K9} = \mathbf{Exponent}[\mathbf{P51num}, T];$$
$$\mathrm{Rcnum} = \mathrm{Factor}[\mathrm{Limit}[\mathrm{Expand}[\mathbf{P51num}/T^{\mathbf{K9}}], T \to \infty]];$$
$$\mathbf{P52den} = \mathbf{Denominator}[\mathbf{P50}];$$
$$\mathrm{K10} = \mathrm{Exponent}[\mathbf{P52den}, T];$$
$$\mathbf{Rcden} = \mathbf{Factor}[\mathbf{Limit}[\mathbf{Expand}[\mathbf{P52den}/T^{\mathbf{K10}}], T \to \infty]];$$
$$\mathbf{Rc} = \mathbf{FullSimplify}[\mathbf{Factor}[\mathbf{Expand}[(\mathbf{Rcnum}/\mathbf{Rcden}) * \tfrac{T^{\mathbf{K9}}}{T^{\mathbf{K10}}}]]]$$

C.2.2. Estimación del estadístico Durbin-Watson

ClearAll;

$Sdy2 = (By^2 + 2 * Sy) * T$ **;**

$$\mathbf{Sdx2} = (\mathbf{Bx}^2 + 2 * \mathbf{Sx}) * T;$$
$$\mathbf{Sdy12} = (\mathbf{By}^2 + 2 * \mathbf{Sy}) * T;$$
$$\mathbf{Sdydx} = \mathbf{Bx} * \mathbf{By} * T;$$
$$\mathbf{Sdydy1} = (\mathbf{By}^2 - \mathbf{Sy}) * T;$$
$$\mathbf{Sdy1dx} = \mathbf{Bx} * \mathbf{By} * T;$$
$$\mathbf{Be} = \frac{\mathbf{BxBySy}}{\mathbf{By^2Sx+Bx^2Sy}};$$
$$\mathrm{De} = \frac{\mathbf{By^2Sx}}{\mathbf{By^2Sx+Bx^2Sy}};$$
$$\mathbf{Pru} = \mathbf{Sdy2} + \mathbf{Be}^2 * \mathbf{Sdx2} + \mathbf{De}^2 * \mathbf{Sdy12} - 2 * \mathbf{Be} * \mathbf{Sdydx} - 2 * \mathbf{De} * \mathbf{Sdydy1} +$$
$$2 * \mathbf{Be} * \mathbf{De} * \mathbf{Sdy1dx};$$
$$\mathbf{R10} = \mathbf{Factor}[\mathbf{Pru}];$$
$$\mathbf{R1num} = \mathbf{Numerator}[\mathbf{R10}];$$
$$\mathrm{R1den} = \mathrm{Denominator}[\mathrm{R10}];$$
$$\mathbf{J5} = \mathbf{Exponent}[\mathbf{R1num}, T];$$
$$\mathrm{J6} = \mathrm{Exponent}[\mathrm{R1den}, T];$$
$$\mathbf{R1num2} = \mathbf{Limit}[\mathbf{Expand}[\mathbf{R1num}/T^{\mathbf{J5}}], T \to \infty];$$
$$\mathrm{R1den2} = \mathrm{Limit}[\mathrm{Expand}[\mathrm{R1den}/T^{\mathrm{J6}}], T \to \infty];$$
$$\mathbf{Pru2} = \mathbf{FullSimplify}[\mathbf{Factor}[\mathbf{Expand}[(\mathbf{R1num2}/\mathbf{R1den2}) * \tfrac{T^{\mathbf{J5}}}{T^{\mathbf{J6}}}]]]$$

C.3. Demostración del teorema 2

C.3.1. Estimación de los parámetros, la varianza y la bondad de ajuste

El código es idéntico al anterior; basta con reemplazar, en la expresión de "**Syy1**", "**C*T**$^{1/2}$" por "**C*T**".

C.3.2. Estimación del estadístico Durbin-Watson

ClearAll;

$Sdy2 = (By^2 + 2 * Sy - 2 * Sy1) * T$;

$$\text{Sdx2} = (\text{Bx}^2 + 2 * \text{Sx} - 2 * \text{Sx1}) * T;$$
$$\text{Sdy12} = (\text{By}^2 + 2 * \text{Sy} - 2 * \text{Sy1}) * T;$$
$$\text{Sdydx} = \text{Bx} * \text{By} * T;$$
$$\text{Sdydy1} = (\text{By}^2 + 2 * \text{Sy1} - \text{Sy2} - \text{Sy}) * T;$$
$$\text{Sdy1dx} = \text{Bx} * \text{By} * T;$$
$$\text{Be} = -\frac{\text{BxBy}(\text{Sy1} - \text{Sy})}{\text{By}^2\text{Sx} + \text{Bx}^2\text{Sy}};$$
$$\text{De} = \frac{\text{Bx}^2\text{Sy1} + \text{By}^2\text{Sx}}{\text{By}^2\text{Sx} + \text{Bx}^2\text{Sy}};$$
$$\text{Pru} = \text{Sdy2} + \text{Be}^2 * \text{Sdx2} + \text{De}^2 * \text{Sdy12} - 2 * \text{Be} * \text{Sdydx} - 2 * \text{De} * \text{Sdydy1} + 2 * \text{Be} * \text{De} * \text{Sdy1dx};$$
$$\text{R10} = \text{Factor}[\text{Pru}];$$
$$\text{R1num} = \text{Numerator}[\text{R10}];$$
$$\text{R1den} = \text{Denominator}[\text{R10}];$$
$$\text{J5} = \text{Exponent}[\text{R1num}, T];$$
$$\text{J6} = \text{Exponent}[\text{R1den}, T];$$
$$\text{R1num2} = \text{Limit}[\text{Expand}[\text{R1num}/T^{\text{J5}}], T \to \infty];$$
$$\text{R1den2} = \text{Limit}[\text{Expand}[\text{R1den}/T^{\text{J6}}], T \to \infty];$$
$$\text{Pru2} = \text{FullSimplify}[\text{Factor}[\text{Expand}[(\text{R1num2}/\text{R1den2}) * \tfrac{T^{\text{J5}}}{T^{\text{J6}}}]]]$$