APPENDIX

This appendix provides the technical coefficients of the yields of carcass, the share of food in domestic supply, and the gross calorific values used between 1916 and 1960. It also contains the specifications, outputs, and checks for the vector error correction models presented in the main text: "Food Security, Trade Specialization, and Violence in Colombia (1916–2016)".

A TECHNICAL COEFFICIENTS (1916–60)

Bellow are presented the coefficients used to figure the estimations of meat, food, and gross calorific values before 1960.

A.1 Carcass yields

Table 1: Carcass yields (kg of meat per head)

Year	Cattle (sex-weighted)	Pigs	Sheep	Goat	Method of obtaining meat	Sources
1918	193	59	21	14	Cattle and pigs: in source. Sheep and goat: own calculation	DGE (1918)
1928	198	60	18	15	Cattle and pigs: in source. Sheep and goat: own calculation	Cattle and pigs: DGE (1928); Sheep, goat: Urrego-Mesa et al. (2019)
1935	186	68			Cattle: in source. Pigs, sheep and goat: own calculation	Cattle: DGE (1935); Pigs, sheep, goat: Urrego-Mesa et al. (2019)
1936	187	66			Cattle and pigs: in source. Sheep and goat: own calculation	Cattle and pigs: DGE (1936); Sheep, goat: Urrego-Mesa et al. (2019)
1937	179	85			Cattle and pigs: in source. Sheep and goat: own calculation	Cattle and pigs: DGE (1937); Sheep, goat: Urrego-Mesa et al. (2019)
1938	199	60			Cattle and pigs: in source. Sheep and goat: own calculation	Cattle and pigs: DGE (1938); Sheep, goat: Urrego-Mesa et al. (2019)
1949	195	68			Cattle: in source. Pigs, sheep and goat: own calculation	Cattle: DGE (1949); Pigs, Sheep, goat: Urrego-Mesa et al. (2019)
1950	201	77			All yields in source	Varela Martínez, Palacio del Valle, Cañón, and Ramírez (1952)
1961	175	59	14	15	All yields in source	Balances sheets in FAOSTAT (2021)

Note: Sometimes yields per head were in the sources, other times only the standing weight before slaughter was available. In the latter case, I use the yield coefficients in Table 2 to get the yield value. Meat production is the slaughter figure multiplied by the yields per head in the range of years available.

Table 2: Yield coefficients for 1950 from Varela (1952)

Cattle (average of both sexes)	Pigs	Sheep	Goat
0.52	0.85	0.57	0.57

Note: Meat production is the slaughter figure multiplied by the yields per head in the range of years available.
Source: Varela Martínez et al. (1952)

A.2 Food in domestic supply

Table 3: The share of food in domestic supply for 1916-60

Agricultural products	**Share of food**
Cereals	53%
Pulses	67%
Roots and Tubers	51%
Vegetables	91%
Fruits	57%
Oil crops	34%
Stimulants	70%
Sugar & Sweeteners	56%
Meat	83%
Dairy products	40%
Animal others	61%

Note: This is the share of food in domestic supply from FAOs' balance sheets. From 1961 I use the percentage resulted in each year. See the methodology section in the main document for details.

A.3 Gross calorific value

Table 4: Gross calorific value coefficients for 1916-60

Agricultural products	**(MJ/Kg)**
Barley	15.37
Cereals, nes	17.3
Maize	15.77
Rice, paddy	15.63
Wheat	15.81
Beans, dry	15.72
Pulses, nes	16.2
Cassava	10.58
Potatoes	7.25
Roots and tubers, nes	9.84
Vegetables, total	5.46
Fruits, other	6.75
Bananas	3.99
Plantains and others	3.99
Oil, Palm	36.75
Oilcrops, Other	32.04
Coconuts	26.79
Seed cotton	32.97
Cocoa, beans	19.66
Coffee, green	19.63
Tobacco, unmanufactured	17.7
Stimulants nes	70.92
Sugar cane	16.76
Sugar, Other	16.66
Meat	14.8
Dairy products	12.36

Note: It is the average value of the categories involved in trade between 1961 and 1963. From 1961 I use specific coefficients to each product. See the methodological section in the main document for details and sources.

B Vector Error Correction Model

Here I give the information on the specifications, the tests, and the different results of the variations of the main model according to the steps suggested in Lütkepohl (2005). I use the function `tseries` from package implemented by Trapletti and Hornik (2020) into the R Core Team (2020) system. To built a VECM we need non-stationary time series integrated in the same order. Therefore, I test for non-stationarity with the Augmented Dickey-Fuller test from `adf.test()` function and integration order with `ndiffs()`. Once I confirmed non-stationarity and I(1) for the time series, moved to estimate the optimal lag order of the model.

First, I looked at the dependency of each variable with `acf()` and the `pacf()` functions to choose the maximum lags and use this value in `VARselect()` function to for the to estimate the optimal lags. I run optimal order for constant specification terms and choose the AIC value as the optimal lag (10 years for the two models) in the Johansen co-integration test with the function `co.jo()`. I validate the number of co-integration relations at the 1% of confidence (Table 2 in the main document) and build the two VECMs with the function `VECM()` from the `urca` package.

Following the main notation of model 1 given in the main document (equations 6, 7, and 8), I estimate one variation of the model to test the intensity of violence $\overline{V}$, instead of the total number of victims (V): this is model 2. For tropical specialization (SP) I use the interaction between the share of land under tropical crops and the amount of these crops in exports and relative prices (P) are the ratio between the international prices for tropical products to cereals. The time series were modelled in logarithms (Section 2.2 for details on the variables and sources in the main text for details).

Although there were not so significant differences between the two models, I choosed the model 1 due to this model fit better the checks for normal distribution. To run the tests of robustness on the models, I transform the VECM to VAR in levels with `vec2var()` function and then check for serial correlation (`serial.test()`), autoregressive conditional heteroscedasticity (`arch.test()`), and normality distribution of the residuals of the model and by each variable (`normality.test()` and `shapiro.test()`).

The following subsections present the outputs and the checks for each of these models.

B.1 Model 1

OUTPUT

$$\begin{pmatrix} \Delta SP_t \\ \Delta V_t \\ \Delta P_t \end{pmatrix} = + \begin{pmatrix} -0.35(0.13)^{*} \\ 0.21(0.37) \\ 0.59(0.52) \end{pmatrix} ECT_{-1} \begin{pmatrix} 9.79(3.58)^{*} \\ -6.43(10.21) \\ -16.26(14.50) \end{pmatrix}$$

$$+ \begin{pmatrix} -0.08(0.18) & -0.13(0.09) & -3.1\text{e-}03(0.06) \\ -0.39(0.52) & -0.75(0.24)^{**} & 0.28(0.18) \\ -0.53(0.74) & 0.25(0.35) & -0.08(0.25) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-1} \\ \Delta V_{t-1} \\ \Delta P_{t-1} \end{pmatrix} + \begin{pmatrix} -0.10(0.18) & 8.1\text{e-}03(0.08) & -0.08(0.06) \\ -0.27(0.52) & -0.05(0.24) & 0.03(0.18) \\ 0.08(0.74) & -0.05(0.34) & -0.18(0.25) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-2} \\ \Delta V_{t-2} \\ \Delta P_{t-2} \end{pmatrix}$$

$$+\begin{pmatrix} -0.29(0.17) & 0.01(0.07) & -0.06(0.06) \\ -0.29(0.47) & 0.42(0.20)^{\cdot} & 0.56(0.18)^{**} \\ -1.30(0.67)^{\cdot} & -0.27(0.28) & -0.11(0.26) \end{pmatrix}\begin{pmatrix} \Delta SP_{t-3} \\ \Delta V_{t-3} \\ \Delta P_{t-3} \end{pmatrix} + \begin{pmatrix} 0.03(0.19) & -0.02(0.07) & 0.11(0.07) \\ 0.33(0.54) & 0.43(0.19)^{*} & 0.62(0.20)^{**} \\ -0.74(0.76) & -0.12(0.27) & -0.22(0.28) \end{pmatrix}\begin{pmatrix} \Delta SP_{t-4} \\ \Delta V_{t-4} \\ \Delta P_{t-4} \end{pmatrix}$$

$$+\begin{pmatrix} -0.15(0.19) & -0.04(0.07) & 0.02(0.07) \\ 0.29(0.55) & 0.68(0.19)^{**} & 0.75(0.19)^{***} \\ 0.10(0.78) & -0.04(0.26) & -0.20(0.26) \end{pmatrix}\begin{pmatrix} \Delta SP_{t-5} \\ \Delta V_{t-5} \\ \Delta P_{t-5} \end{pmatrix} + \begin{pmatrix} -0.23(0.19) & -0.06(0.07) & -4.4\text{e-}03(0.07) \\ 1.81(0.55)^{**} & 0.73(0.20)^{**} & 0.07(0.20) \\ -0.93(0.79) & -0.06(0.29) & -0.26(0.28) \end{pmatrix}\begin{pmatrix} \Delta SP_{t-6} \\ \Delta V_{t-6} \\ \Delta P_{t-6} \end{pmatrix}$$

$$+\begin{pmatrix} 0.15(0.21) & -0.01(0.06) & -0.02(0.06) \\ 2.27(0.61)^{**} & 0.45(0.18)^{*} & 0.65(0.16)^{***} \\ -0.51(0.87) & 0.12(0.26) & -0.08(0.23) \end{pmatrix}\begin{pmatrix} \Delta SP_{t-7} \\ \Delta V_{t-7} \\ \Delta P_{t-7} \end{pmatrix} + \begin{pmatrix} -0.13(0.23) & -0.12(0.06)^{*} & 1.9\text{e-}03(0.07) \\ 2.08(0.64)^{**} & 0.52(0.16)^{**} & 0.60(0.19)^{**} \\ 0.33(0.91) & 0.15(0.22) & -0.10(0.26) \end{pmatrix}\begin{pmatrix} \Delta SP_{t-8} \\ \Delta V_{t-8} \\ \Delta P_{t-8} \end{pmatrix}$$

$$+ \begin{pmatrix} -0.60(0.22)^{*} & -0.06(0.05) & 0.04(0.06) \\ -0.59(0.63) & 0.36(0.15)^{*} & 0.46(0.18)^{*} \\ 0.32(0.89) & 0.11(0.21) & 4.3\text{e-}03(0.25) \end{pmatrix}\begin{pmatrix} \Delta SP_{t-9} \\ \Delta V_{t-9} \\ \Delta P_{t-9} \end{pmatrix}$$

ROBUSTNESS CHECKS

Table 5: Checks for model 1

Test	Chi-squared	df	p-value
Portmanteau Test (asymptotic)	53.12	3	1.72e-12
ARCH (multivariate)	96	1080	1
JB-Test (multivariate)	1.61	6	0.95
Skewness only (multivariate)	0.33	3	0.95
Kurtosis only (multivariate)	1.28	3	0.73

Table 6: Shapiro-Wilk normality test for the residuals of the model 1 and for each variable

	Statistic	P-Value
Model 1	0.98	0.05
SP	0.97	0.39
V	0.98	0.71
P	0.98	0.80

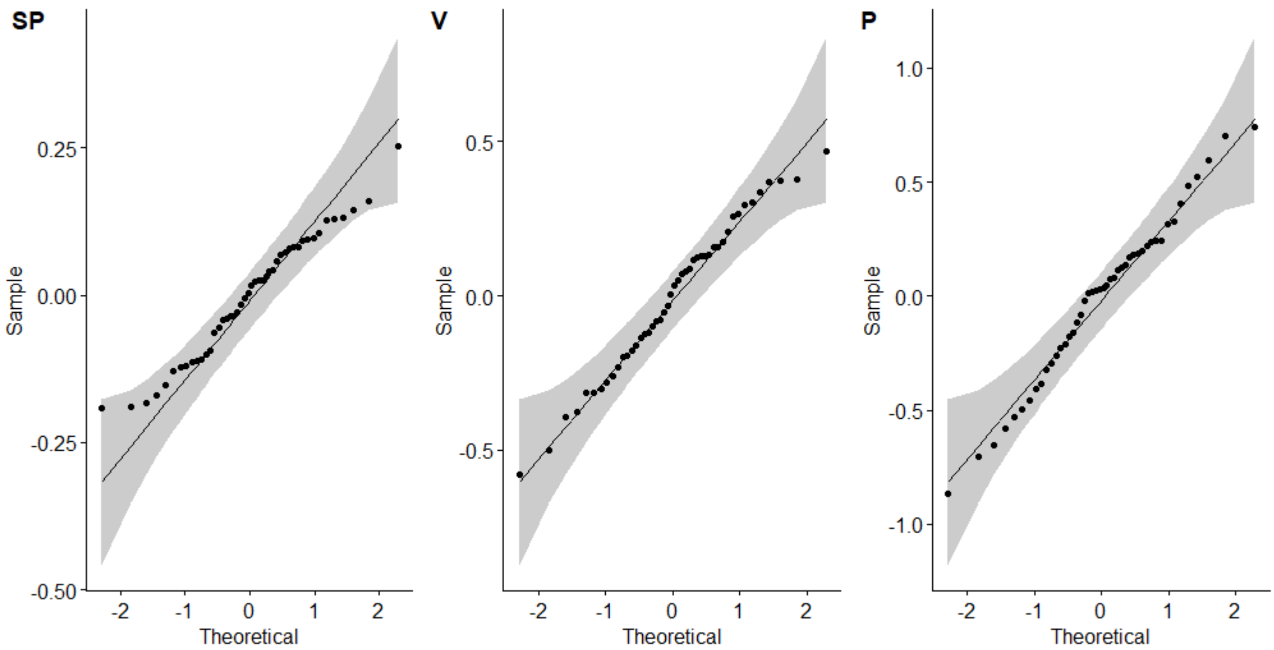

Figure 1: Model 1: distribution for the residuals of SP, V, and P

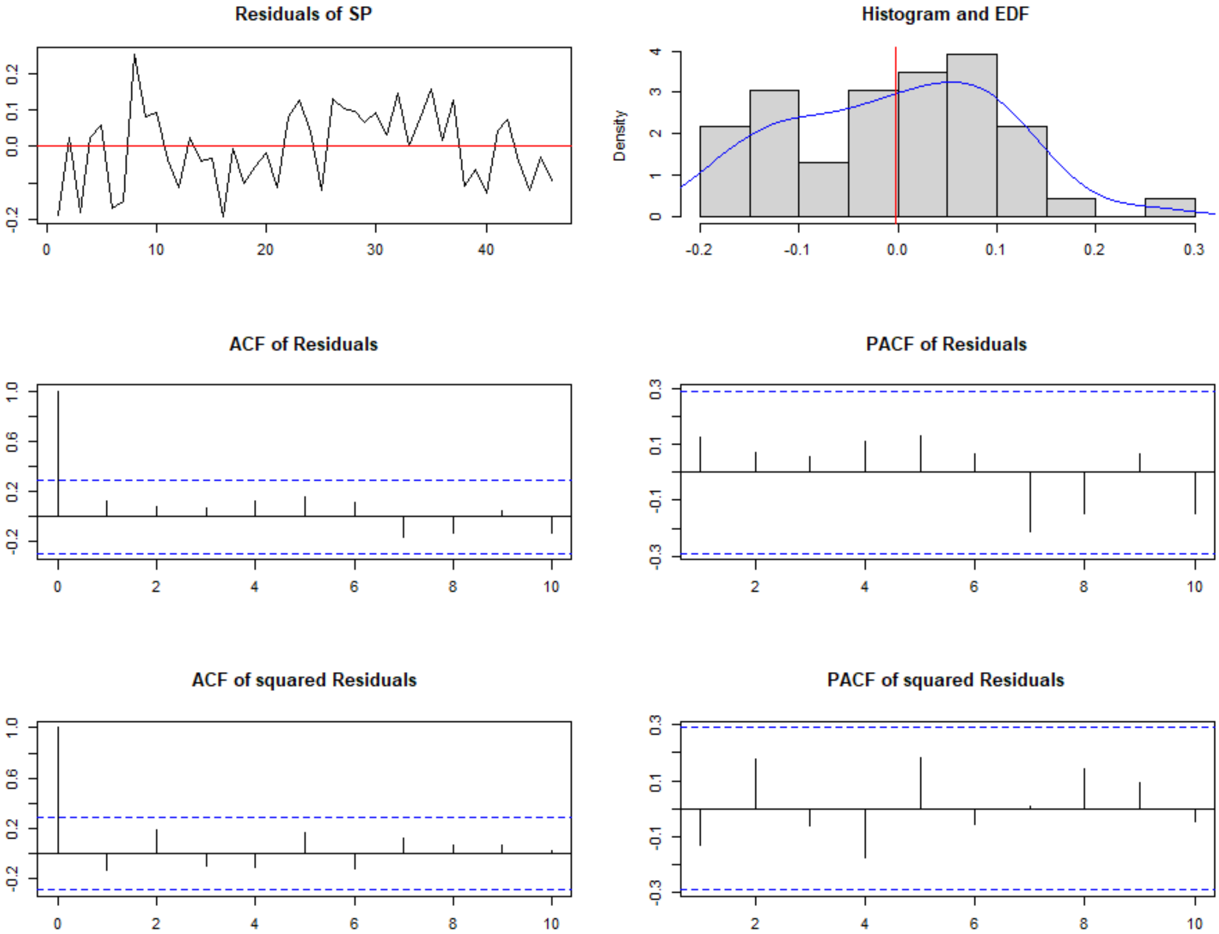

Figure 2: Model 1: ACF and PACF of the residual of SP

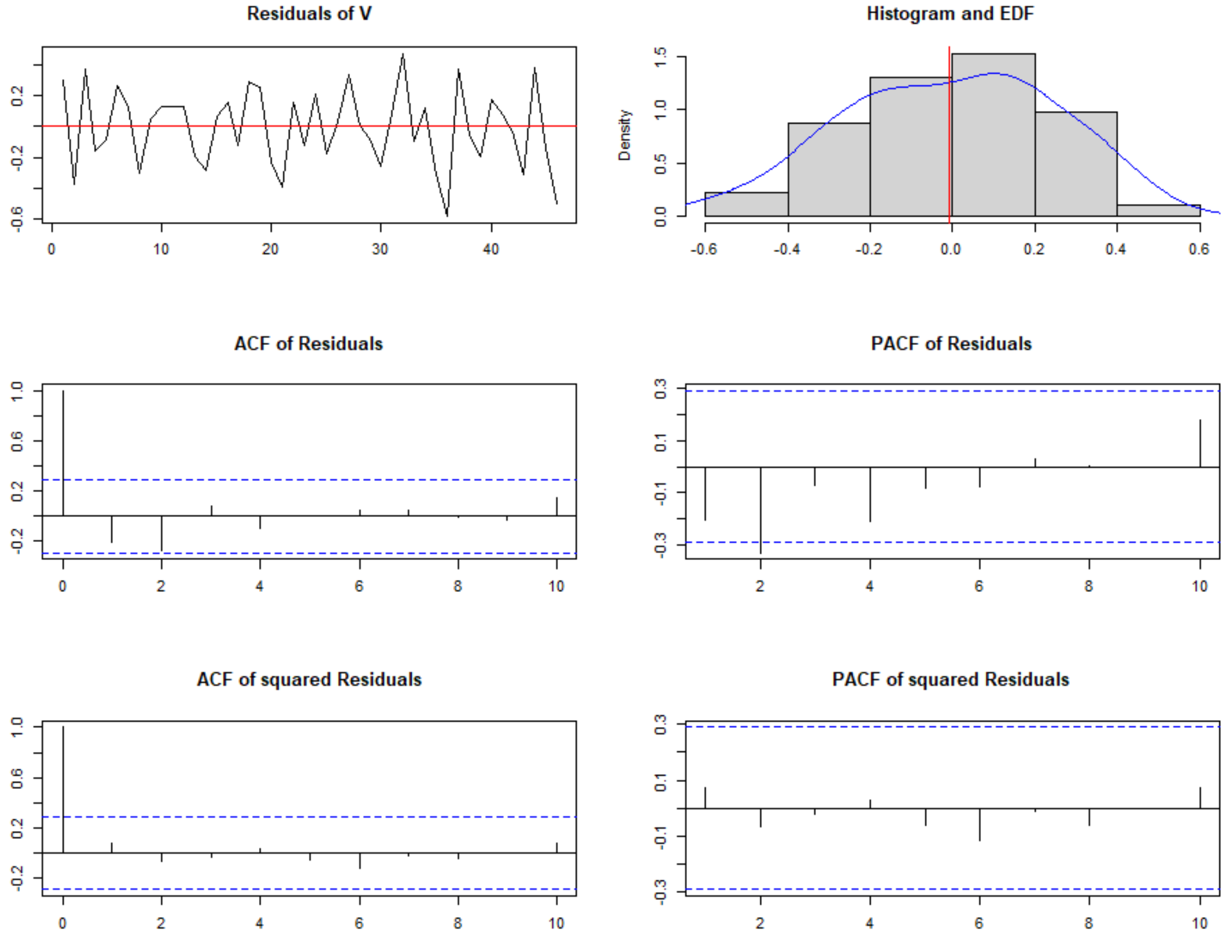

Figure 3: Model 1: ACF and PACF of the residual of V

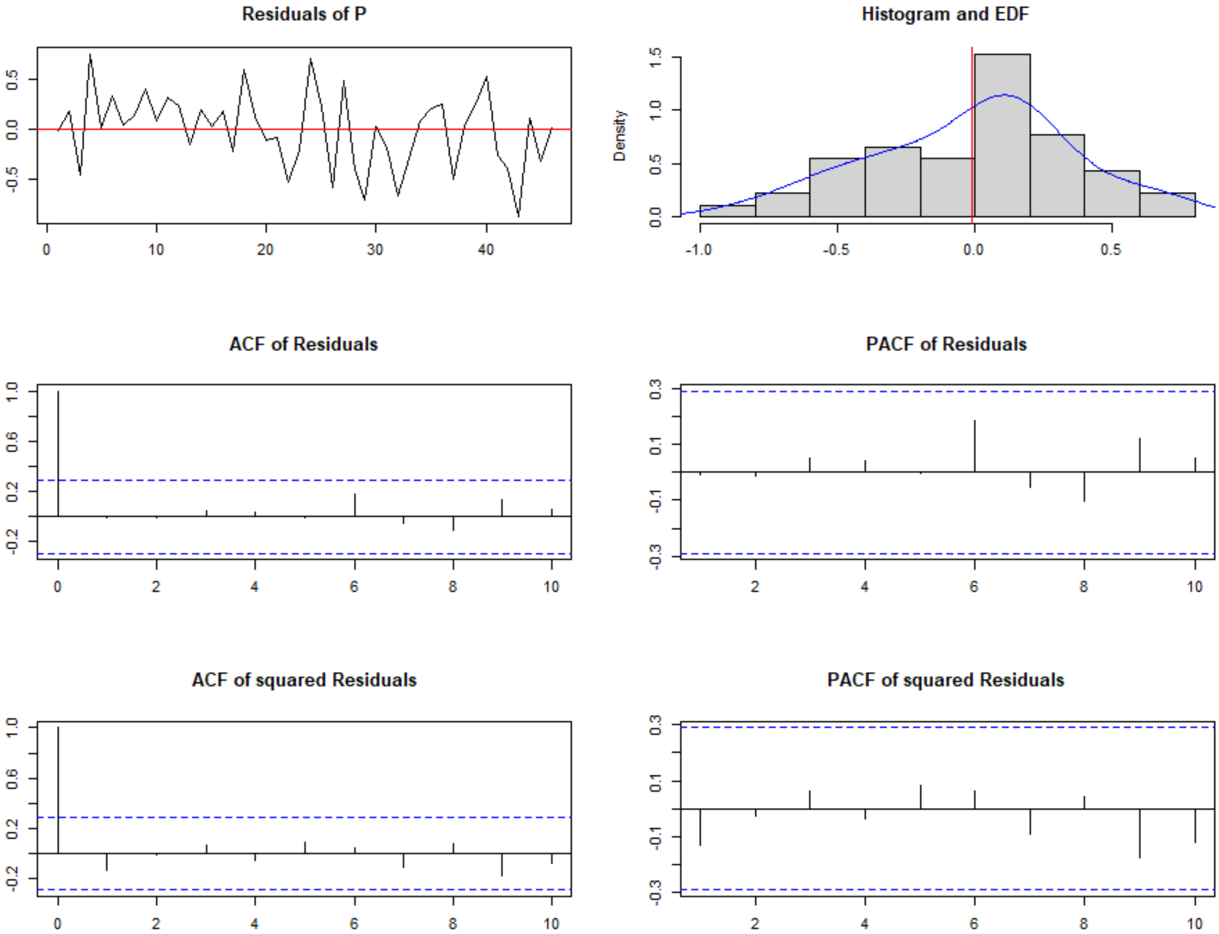

Figure 4: Model 1: ACF and PACF of the residual of P

B.2 Model 2

NOTATION

$$\Delta SP_t = \theta_1 + \sum_{i=1}^{p} + [\alpha_{1i}\Delta SP_{t-i} + \beta_{1i}\Delta \overline{V}_{t-i} + \psi_{1i}\Delta P_{t-i}] + \mu ECT_{t-1} + \epsilon_{1t} \quad (1)$$

$$\Delta \overline{V}_t = \theta_2 + \sum_{i=1}^{p} + [\alpha_{2i}\Delta SP_{t-i} + \beta_{2i}\Delta \overline{V}_{t-i} + \psi_{2i}\Delta P_{t-i}] + \mu ECT_{t-1} + \epsilon_{2t} \quad (2)$$

$$\Delta P_t = \theta_3 + \sum_{i=1}^{p} + [\alpha_{3i}\Delta SP_{t-i} + \beta_{3i}\Delta \overline{V}_{t-i} + \psi_{3i}\Delta P_{t-i}] + \mu ECT_{t-1} + \epsilon_{3t} \quad (3)$$

OUTPUT

$$\begin{pmatrix} \Delta SP_t \\ \Delta \overline{V}_t \\ \Delta P_t \end{pmatrix} = + \begin{pmatrix} -0.30(0.18) \\ -0.99(0.32)^{**} \\ -0.67(0.58) \end{pmatrix} ECT_{-1} \begin{pmatrix} 10.68(6.55) \\ 35.07(11.42)^{**} \\ 24.00(20.76) \end{pmatrix}$$

$$+ \begin{pmatrix} -0.08(0.24) & 0.34(0.20)^{\cdot} & -0.04(0.09) \\ 0.72(0.42) & 0.43(0.34) & -0.02(0.15) \\ 0.16(0.76) & 0.39(0.62) & -0.07(0.28) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-1} \\ \Delta \overline{V}_{t-1} \\ \Delta P_{t-1} \end{pmatrix} + \begin{pmatrix} -0.04(0.22) & 0.25(0.18) & -0.08(0.08) \\ 0.83(0.39)^{*} & 0.51(0.31) & -0.13(0.15) \\ 0.13(0.71) & 0.31(0.56) & -0.58(0.27)^{*} \end{pmatrix} \begin{pmatrix} \Delta SP_{t-2} \\ \Delta \overline{V}_{t-2} \\ \Delta P_{t-2} \end{pmatrix}$$

$$+ \begin{pmatrix} -0.13(0.24) & 0.19(0.14) & -0.08(0.09) \\ 0.70(0.41) & 0.80(0.24)^{**} & -0.13(0.16) \\ -0.55(0.75) & 0.16(0.43) & -0.08(0.30) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-3} \\ \Delta \overline{V}_{t-3} \\ \Delta P_{t-3} \end{pmatrix} + \begin{pmatrix} 0.02(0.23) & 0.13(0.13) & -0.05(0.10) \\ 0.78(0.40)^{\cdot} & 0.81(0.22)^{**} & -0.03(0.18) \\ -0.65(0.73) & 0.13(0.40) & -0.57(0.33) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-4} \\ \Delta \overline{V}_{t-4} \\ \Delta P_{t-4} \end{pmatrix}$$

$$+ \begin{pmatrix} -0.05(0.23) & 0.15(0.12) & -0.09(0.09) \\ 0.53(0.40) & 0.56(0.21)^{*} & 0.09(0.15) \\ 0.51(0.73) & 0.12(0.38) & -0.16(0.27) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-5} \\ \Delta \overline{V}_{t-5} \\ \Delta P_{t-5} \end{pmatrix} + \begin{pmatrix} -3.8\text{e-}03(0.23) & 0.09(0.10) & -0.06(0.09) \\ 0.69(0.41) & 0.47(0.17)^{*} & -0.23(0.16) \\ -0.36(0.74) & -0.15(0.31) & -0.39(0.29) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-6} \\ \Delta \overline{V}_{t-6} \\ \Delta P_{t-6} \end{pmatrix}$$

$$+ \begin{pmatrix} -0.05(0.23) & 0.08(0.08) & -0.14(0.09) \\ 1.08(0.40)^{*} & 0.24(0.15) & -0.16(0.16) \\ 0.23(0.73) & 0.02(0.27) & -0.18(0.29) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-7} \\ \Delta \overline{V}_{t-7} \\ \Delta P_{t-7} \end{pmatrix} + \begin{pmatrix} 0.01(0.26) & 0.12(0.06)^{\cdot} & -0.02(0.08) \\ 0.06(0.46) & 0.16(0.11) & -0.28(0.14)^{\cdot} \\ 1.05(0.84) & -0.20(0.20) & -0.18(0.25) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-8} \\ \Delta \overline{V}_{t-8} \\ \Delta P_{t-8} \end{pmatrix}$$

$$+ \begin{pmatrix} -0.17(0.28) & 0.07(0.06) & -0.01(0.08) \\ -0.84(0.49) & 0.07(0.10) & -0.25(0.13)^{\cdot} \\ 0.06(0.89) & 0.07(0.18) & -0.14(0.24) \end{pmatrix} \begin{pmatrix} \Delta SP_{t-9} \\ \Delta \overline{V}_{t-9} \\ \Delta P_{t-9} \end{pmatrix}$$

Table 7: Checks for model 1

Test	Chi-squared	df	p-value
Portmanteau Test (asymptotic)	71.54	3	1.99e-16
ARCH (multivariate)	96	1080	1
JB-Test (multivariate)	8.93	6	0.18
Skewness only (multivariate)	4.9	3	0.18
Kurtosis only (multivariate)	4.03	3	0.25

Table 8: Shapiro-Wilk normality test for the residuals of the model 2 and for each variable

	Statistic	P-Value
Model 2	0.96	0.001
SP	0.98	0.85
$\overline{V}$	0.96	0.13
P	0.97	0.34

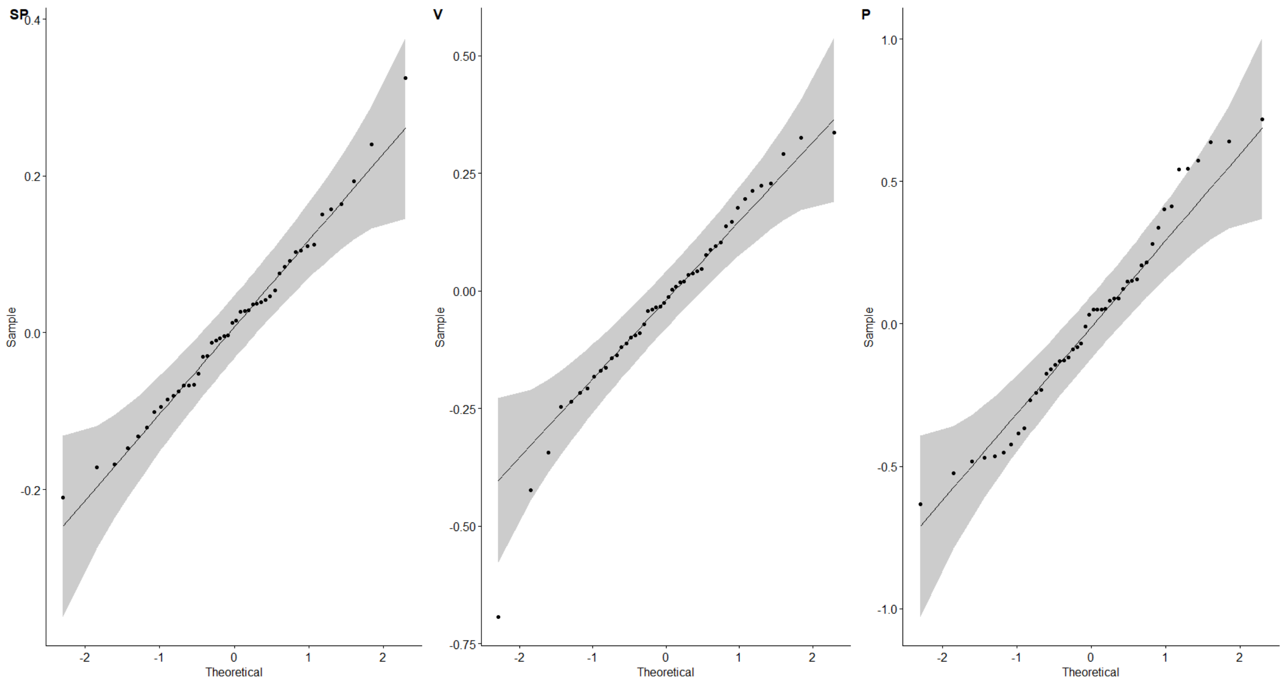

Figure 5: Model 2: distribution for the residuals of SP, $\overline{V}$, and P

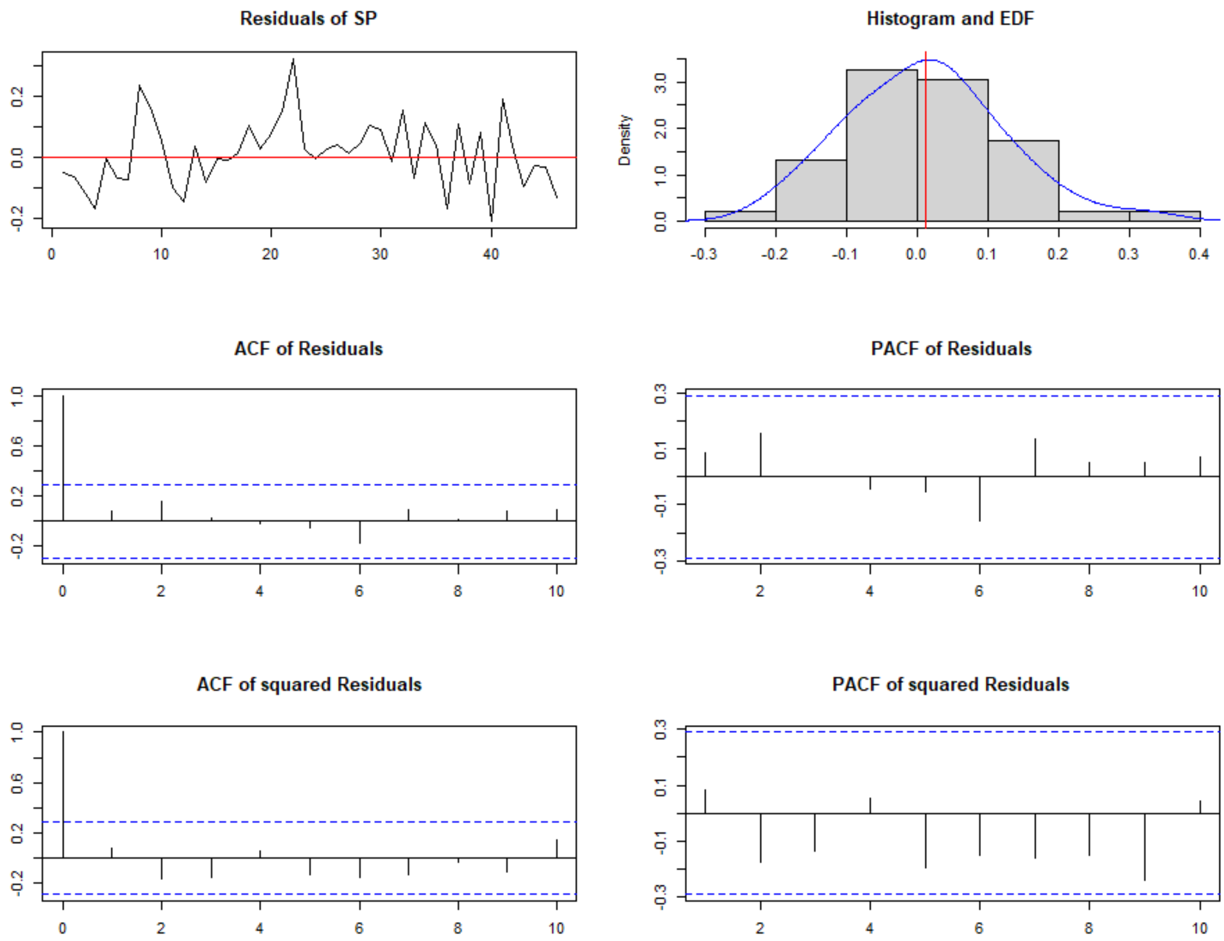

Figure 6: Model 2: ACF and PACF of the residual of SP

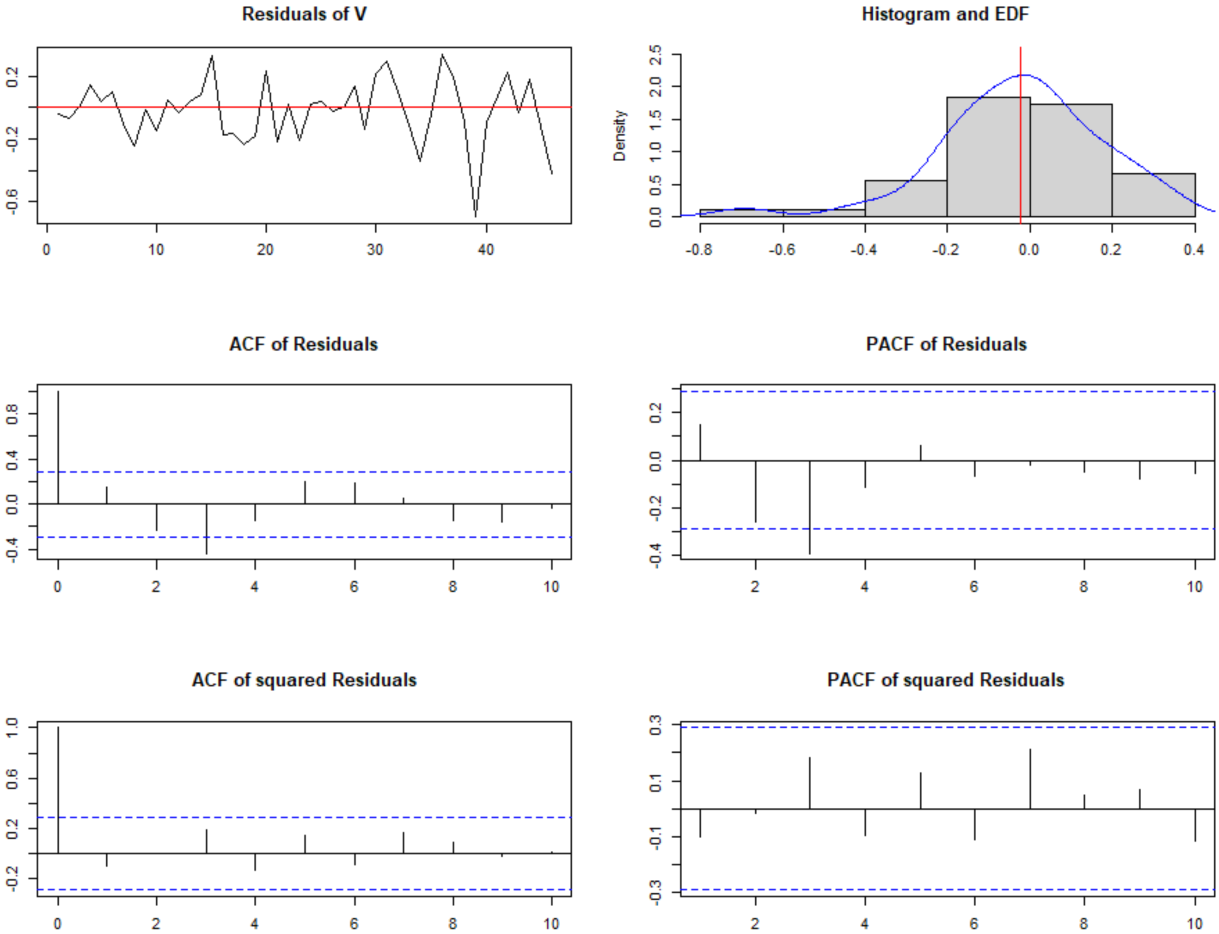

Figure 7: Model 2: ACF and PACF of the residual of $\overline{V}$

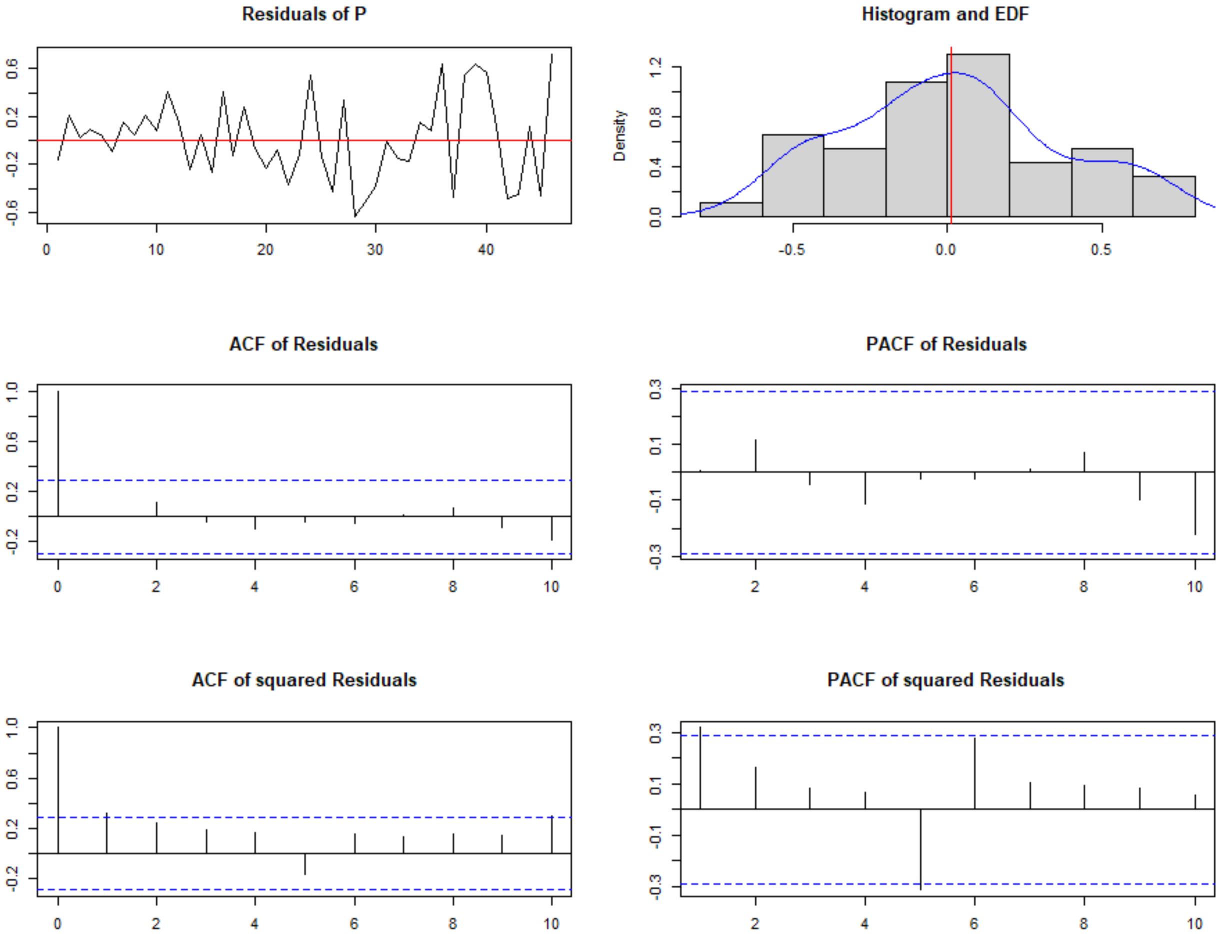

Figure 8: Model 2: ACF and PACF of the residual of P

References

DGE (Ed.). (1918). *Anuario estadístico.* Colombia, Dirección General de Estadística.

DGE (Ed.). (1928). *Anuario estadístico.* Colombia, Dirección General de Estadística.

DGE (Ed.). (1935). *Anuario estadístico.* Colombia, Dirección General de Estadística.

DGE (Ed.). (1936). *Anuario estadístico.* Colombia, Dirección General de Estadística.

DGE (Ed.). (1937). *Anuario estadístico.* Colombia, Dirección General de Estadística.

DGE (Ed.). (1938). *Anuario estadístico.* Colombia, Dirección General de Estadística.

DGE (Ed.). (1949). *Anuario estadístico.* Colombia, Dirección General de Estadística.

FAOSTAT. (2021). *Food and agriculture database.* Retrieved 2021-03-31, from http://www.fao.org/faostat/en/

Lütkepohl, H. (2005). *New introduction to multiple time series analysis.* Springer Science & Business Media.

R Core Team. (2020). R: A language and environment for statistical computing [Computer software manual]. Vienna, Austria. Retrieved from https://www.R-project.org/

Trapletti, A., & Hornik, K. (2020). tseries: Time Series Analysis and Computational Finance [Computer software manual]. Retrieved from https://CRAN.R-project.org/package=tseries (R package version 0.10-48.)

Urrego-Mesa, A., Infante-Amate, J., & Tello, E. (2019). Pastures and Cash Crops: Biomass Flows in the Socio-Metabolic Transition of Twentieth-Century Colombian Agriculture. *Sustainability*, *11*(1). doi: 10.3390/su11010117

Varela Martínez, R., Palacio del Valle, G., Cañón, J., & Ramírez, E. (1952). *Economía agropecuaria de Colombia en 1950.* Bogotá: Ministerio de Agricultura.