Progressive Taxation in Romania - An Analysis by Scenarios

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Abstract

The regional geopolitical tensions, the changes in the regional markets of energy products and food that led to the increase of prices and the stagnation of economic growth at the level of the European Union highlighting the need to review the management of public policies.

Thus, under the pressure of growing public and private debts, under the pressure of budget deficits, the fiscal policies of the EU27 states often have the unpleasant task of making substantial reforms of the taxation systems. Therefore, the article proposes the construction of a series of scenarios regarding the possibility of returning to the progressive taxation of the payroll tax in Romania. The article tries to highlight the advantages and where benefits can intervene for the structure of the national budget starting from the analysis of a series of scenarios regarding the progressive taxation of salaries and proposals are outlined in this regard.

Key words: salary tax, income inequality, personal income tax, progressiveness
J.E.L. classification: H21, H24, H31

1. Introduction

The recent international developments, interspersed with local wars, rising inflation, declining economic growth increasingly outline the need for a consistent fiscal-budgetary space at the European level, which allows additional expenses to be made when the situation requires it. At the level of Romania, the entry into the excessive deficit procedure in the period close to the COVID-19 pandemic allowed its suspension as well as a momentary relaxation. However, it also led to constant pressure from the European Commission for the gradual realization of fiscal consolidation and the achievement of the deficit target for the next period 2024-2026. Fiscal consolidation involves simplifying taxation and harmonizing it with the business environment, careful control of expenses and increasing tax revenues. Thus, according to the report of the Ministry of Finance (2023), the general consolidated budget deficit according to the ESA should decrease from 6.2% of GDP in 2022 to 4.4% of GDP in 2023, reaching in 2025-2026 to 2, 9% of GDP. This evolution must also allow the reduction of inflation and the stimulation of healthy economic growth, as well as the protection of the vulnerable categories of the population and the correct placement of employment at wage levels that allow a decent and prosperous life.

In this sense, Romania, through its fiscal-budgetary authorities, must make efforts to restore the budgetary parameters, including through the system of taxes and fees. In addition to the recently announced measures, which can to some extent lead to the improvement of the budget performance, broader measures are also necessary, to frame taxation in the Western European reference system, in the implementation of a more or less progressive tax system (with more or less tranches). In this sense, using the primary data of the National Agency for Fiscal Administration (NAFA) for the year 2022, it has been built a set of scenarios, with three progressive rates. From these we selected a single model, with three rates, the most likely and potential to be implemented and used an Auto-Regressive Moving Average (ARMA) Box-Jenkins methodology, generally used for univariate time series forecasting. The real results can only be in agreement to a certain extent with the econometric simulations, and can indicate possible developments that can assist political decision-makers in order to implement sound fiscal policies.

2. Literature review

A number of important fields can only function properly with the support of the budgetary apparatus such as: infrastructure, defence, public order, education, research, culture, industry, etc. The financing of these fields constantly requires the improvement of the ratio between public revenues and expenditures. Thus, fiscal consolidation should be the preferred way to align demand more with supply, to reduce internal and external vulnerabilities, to avoid placing unnecessary burdens on monetary policy, but also to ensure the implementation of the reforms of the National Recovery Plan and Resilience (PNRR) (European Commission, 2023, SWD(2023) 642 final). Fiscal consolidation should be considered bearing in mind that there are numerous studies (Sargent and Wallace, 1981; Blanchard, 1993; Kawai and Maccini, 1995; Budina, and Van Wijnbergen, 2000, etc.) that talk about the fiscal roots of inflation and investigate the implications the sustainability of the fiscal policy on the stabilization of inflation in the region of Central and Eastern Europe and especially in Romania.

Equally, in the study of Cournède et al. (2014) state that if too little attention is paid to the mix of instruments used to achieve consolidation, it can undermine long-term growth, exacerbate income inequality and slow down the global rebalancing process.

So the control of adverse effects must be taken into account, and fiscal progressivity must be seriously considered for improving fiscal consolidation only after the structural elements of the labour market are regulated. However, in the case of Romania, there are still numerous exemptions, deductions, particular cases, anomalies, which make the existence of the pure single quota only theoretical. In the case of Romania, intervention should first be taken to reduce social contributions and cap them, as well as natural steps to raise the level of the minimum wage in the economy and the average wage, depending on the capacity of the labour market.

But in order to be able to integrate the idea of wage progressivity, the evolution of the phenomenon over time should also be seen. Thus, regarding prediction models, using time series, studies generally use AR(I)MA (Auto-Regressive (Integrated) Moving Average) models (Box, Jenkins and Reinsel, 1994) for a series of raw materials and products, for GDP evolution, but also for fiscal elements, such as deficit and public debt (Bowman & Husain, 2004; Stoian, 2008; Goswami and Hossain, 2013; Cortez et al., 2018; Ericsson, 2017; Abonazel & Abdelftah , 2019; Navapan and Boonyakunakorn, 2017; Zhuravka et al., 2019, etc.).

In specialized studies, despite some progress in the use of ARIMA/ARMA type modelling for a number of important budgetary fiscal indicators, regarding the budget deficit and domestic parameters such as personal income tax and, more specifically, payroll tax, there are still huge possibilities for developing new applications. In this sense, the aim of the paper is to predict the future values of the evolution of the salary tax, using the ARMA model, starting from the analysis of the evolutions of the receipts from this tax, on income tranches.

3. Research methodology

Considering the concerns for the future evolutions of the macroeconomic parameters, regarding the budget deficit, this article aims to develop a suitable model to predict, based on some time series, the evolution of the income from the salary tax in Romania. Thus, the paper uses NAFA monthly data for payroll tax for 2022 and extending the time series for the period 2020m1-2024m1, the forecast being made until 2030m1, based on the Box-Jenkings ARIMA model at the level of a single scenario, considered the most probable. For the year 2024, the payroll tax time series is adjusted according to scenarios of fiscal progressivity with 3 income rates. The income tranches are: t1 - 0-2549 lei; t2 - 2550-8000 lei; t3 - 8001-10000 lei; t4 - 10,001-15,000 lei; t5 - over 15,000 lei, according to NAFAinformation. From these scenarios, the forecast is continued based on the ARMA model in tranches only for a single scenario with three rates (scenario 2), namely with shares of: 10% (for t1 and t2); 18% (for t3) and 23% (for t4 and t5).

According to specialist studies (e.g. D'Amico, 2020) the Box-Jenkins (1970) models contain three stages of elaboration: identification, estimation and diagnosis and prediction. For the identification step, Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) correlograms were used in this paper. For non-stationary time series, first-order

differencing is used to make the series stationary. If the series is non-stationary an ARIMA model is used, and if it is stationary ARMA.

In our case, the tranche analyses on the initial time series, demonstrate that both the analysis based on correlograms (see appendix) and based on the study of the Augmented Dickey – Fuller (ADF) test, which presents stationarity at the level, the selected model is ARMA type.

Table no. 1 Augmented Dickey - Fuller (ADF) Unit Root Stationary Test result on income brackets for payroll tax

Series	Level	Critical value	
	Constant & Trend (t – statistic, and p-value)	5%	1%
SC2T1	-4,913908	-3,487845	-4,121303
	0.0010*		
SC2T2	-5,962013	-3,487845	-4,121303
	0.0000*		
SC2T3	-3,757089	-3,510740	-4,170583
	0.0282*		
SC2T4	-3,636355	-3,508508	-4,165756
	0.0373*		
SC2T5	-4,604641	-3,508508	-4,165756
	0.0030*		

Source: Own research, using annual Eurostat data and Eviews12 software. Notations: SC- Scenario; t- tranche. Numbers with * indicate critical unilateral p values of the ADF test (obtained from MacKinnon, 1996).

In the autoregressive (AR) process, the independent values will be the past values of the dependent variable, and the general form of the autoregressive model will be as follows:

$y_t = a_0 + a_1 y_{t-1} + \ldots + a_p y_{t-p} + \varepsilon_t$

The above equation is the general representation of the AR (p) model, where a_0, a_1 ...ap are the constants and $y_{t-1} ... y_{t-p}$ are the past values of the dependent variable. As for the moving average (MA), the general form of the equation is as follows:

$y_t = a_0 + \varepsilon_t + b_1 \varepsilon_{t-1} + \ldots + b_q \varepsilon_{t-q}$

In the above equation, a_0, b_1, ...b_q are constants and $\varepsilon_t, \varepsilon_{t-1} ... \varepsilon_{t-q}$, are the past values of the error terms. The combined process of AR and MA process is ARMA. Thus, the equation obtained after combining the above equations is the general representation of the ARMA (p, q) model:

$y_t = a_0 + a_1 y_{t-1} + \ldots + a_p y_{t-p} + \varepsilon_t + b_1 \varepsilon_{t-1} + \ldots + b_q \varepsilon_{t-q}$

This final equation is valid in our case, dealing with an ARMA model. At the same time, the primary data provided by NAFA for 2022 are presented below, and the series is completed with a minor adjustment for 2023, which we assume as a result of the fiscal measures taken by the government in 2023 to improve fiscal performance.

Table no. 2 The evolution of the salary tax in Romania in 2022 by income tranches and by calendar months (million lei)

2022 (months)	0-2549	2550-8000	8001-10000	10001-15000	>15000	Total
1	53.29	973.98	192.97	222.17	246.06	**1688.47**
2	51.8	976.18	194.16	219.68	258.72	**1700.54**
3	55.04	986.6	202.85	236.37	330.92	**1811.78**
4	50.5	991.15	206.78	253.07	326.43	**1827.93**
5	50.87	1011.98	218.45	250.52	292.6	**1824.42**
6	47.23	962.63	213.51	251.89	300.24	**1775.5**
7	45.99	966.09	206.03	252.77	293.67	**1764.55**
8	42.57	974.59	212.9	244.29	285.91	**1760.26**
9	45.67	951.47	217.43	252.87	305.64	**1773.08**
10	53.95	977.07	225.21	266.74	302.34	**1825.31**
11	43.62	968.19	235.1	288.93	341.77	**1877.61**
12	46.63	933.3	230.9	329.72	458.58	**1999.13**
Total	**587.16**	**11673.23**	**2556.29**	**3069.02**	**3742.88**	**21628.58**

Source: National Agency for Fiscal Administration (NAFA)

4. Results and discussions

Taking into account the existence of the primary information provided by NAFA, we elaborate on the basis of the history of tranches of the salary tax used by Romania in the past three sets of scenarios with three income rates.

We thus observe in the "Difference" section that models offer some advantage in relation to current performance, and fiscal progressivity, understood even in the sense of a modest progressivity (with only 3 rates) can bring benefits to the state budget. However, we choose the most precarious scenario, scenario 2 with odds of 10%, 18% and 23% in order not to risk unnecessarily. It should be noted that the tax rate is seen in this study as applying only to the tranche in question, and if we take into account the possible separate classification of the income into several tranches (as it should actually be), we should adjust from the global amount annually with approximately 1 billion lei.

Table no.3 The evolution of the salary tax in Romania in 2024 according to scenarios with three tranches (million lei)

2024 (income tranches)	**0-2549**	**2550-8000**	**8001-10000**	**10001-15000**	**>15000**	**Total**	**Difference Previous year**
Scenario 1 (rates)	**10%**	**16%**	**16%**	**21%**	**21%**		
1	54.29	1559.97	310.35	468.66	518.83	**2912.09**	**1218.62**
2	52.80	1563.49	312.26	463.43	545.41	**2937.38**	**1231.84**
3	56.04	1580.16	326.16	498.48	697.03	**3157.87**	**1341.09**
4	51.50	1587.44	332.45	533.55	687.60	**3192.54**	**1359.61**
5	51.87	1620.77	351.12	528.19	616.56	**3168.51**	**1339.09**
6	48.23	1541.81	343.22	531.07	632.60	**3096.93**	**1316.43**
7	46.99	1547.34	331.25	532.92	618.81	**3077.31**	**1307.76**
8	43.57	1560.94	342.24	515.11	602.51	**3064.37**	**1299.11**
9	46.67	1523.95	349.49	533.13	643.94	**3097.18**	**1319.10**
10	54.95	1564.91	361.94	562.25	637.01	**3181.07**	**1350.76**
11	44.62	1550.70	377.76	608.85	719.82	**3301.75**	**1419.14**
12	47.63	1494.88	371.04	694.51	965.12	**3573.18**	**1569.05**
Total	599.16	18696.37	4109.26	6470.14	7885.25	**37760.18**	**16071.60**
Scenario 2 (rates)	**10%**	**10%**	**18%**	**23%**	**23%**	**Total**	**Difference Previous year**
1	54.29	974.98	349.15	513.29	568.24	**2459.95**	**766.48**
2	52.80	977.18	351.29	507.56	597.36	**2486.19**	**780.65**
3	56.04	987.60	366.93	545.95	763.42	**2719.94**	**903.16**
4	51.50	992.15	374.00	584.36	753.09	**2755.10**	**922.17**
5	51.87	1012.98	395.01	578.50	675.28	**2713.64**	**884.22**
6	48.23	963.63	386.12	581.65	692.85	**2672.48**	**891.98**
7	46.99	967.09	372.65	583.67	677.74	**2648.15**	**878.60**
8	43.57	975.59	385.02	564.17	659.89	**2628.24**	**862.98**
9	46.67	952.47	393.17	583.90	705.27	**2681.49**	**903.41**
10	54.95	978.07	407.18	615.80	697.68	**2753.68**	**923.37**
11	44.62	969.19	424.98	666.84	788.37	**2894.00**	**1011.39**
12	47.63	934.30	417.42	760.66	1057.03	**3217.04**	**1212.91**
Total	599.16	11685.23	4622.92	7086.35	8636.22	**32629.88**	**10941.30**
Scenario 3 (rates)	**10%**	**10%**	**16%**	**34%**	**34%**	**Total**	**Difference Previous year**
1	54.29	974.98	310.35	758.78	840.00	**2938.40**	**1244.93**
2	52.80	977.18	312.26	750.31	883.05	**2975.60**	**1270.06**
3	56.04	987.60	326.16	807.06	1128.53	**3305.39**	**1488.61**
4	51.50	992.15	332.45	863.84	1113.26	**3353.20**	**1520.27**
5	51.87	1012.98	351.12	855.17	998.24	**3269.38**	**1439.96**
6	48.23	963.63	343.22	859.83	1024.22	**3239.12**	**1458.62**
7	46.99	967.09	331.25	862.82	1001.88	**3210.02**	**1440.47**
8	43.57	975.59	342.24	833.99	975.49	**3170.88**	**1405.62**
9	46.67	952.47	349.49	863.16	1042.58	**3254.36**	**1476.28**
10	54.95	978.07	361.94	910.32	1031.36	**3336.63**	**1506.32**
11	44.62	969.19	377.76	985.76	1165.42	**3542.75**	**1660.14**
12	47.63	934.30	371.04	1124.45	1562.57	**4039.99**	**2035.86**
Total	**599.16**	**11685.23**	**4109.26**	**10475.47**	**12766.59**	**39635.71**	**17947.13**

Sources: author's calculations, initial NAFA data

However, given that in the proposed scenario, scenario 2, the first two tranches retain the current 10% share, to allow raising the minimum income to the average one, and the number of employees on these tranches is considerable, over 4 thousand employees from the 5 .0673 million employees at the level of December 2022 (INS, monthly bulletin no. 6/2023), we can consider the calculations broadly correct.

Thus, after choosing scenario 2 with three tranches we continue the analysis. From the correlograms in the appendix and from the ADF test presented above, it is clear that the analysed time series are stationary and we will use an ARMA type model.

Correlograms for the autocorrelation function (ACF) and partial autocorrelation function (PACF) for all income tranches on the selected model (scenario 2 with three tranches) were presented in the appendix. Correlograms are used to correctly choose p, q, and d values for models and to identify AR and MA process terms. Thus, series of alternative models are built for the estimation process, being rather an art in establishing the most suitable ARMA model.

Thus, in the estimation phase, we must follow the significance of the AR and MA components, which must have a p-value below 0.05. At the same time, we should compare the Akaike, Schwartz and Hannan-Quinn information criteria, preferring the model with the three lowest information values (D'Amico, 2020). From the exposition of these values we can decide the most suitable model, without claiming that it is perfect, but that it is the best possible model to choose for the evolution of the payroll tax, on tranches. Centralized the result for all tranches is presented below. (Table 4).

Table 4. - The result of the ARMA estimations and the selection of the appropriate ARMA model for scenario 2 with three rates

	SC2T1	SC2T2	SC2T3	SC2T4	SC2T5
Models (AR, integration, MA)	**(1,0,3)**	**(12,0,7)**	**(1, 0,0)**	**(1,0,0)**	**(1,0,0)**
R2	0,350335	0,370129	0,942977	0,932539	0,865906
R2 adjusted	0,315531	0,336386	0,940977	0,930172	0,861201
AR p-value	0,0023	0,0000	0,0000	0,0000	0,0000
MA p-value	0,0047	0,0002	-	-	-
Log-likelihood	-167,7981	-250,0532	-264,7968	-309,0842	-347,5492
Akaike info criterion (AIC)	5,726604	8,468441	8,926561	10,402810	11,684970
Schwarz criterion (SC)	5,866227	8,608064	9,031278	10,507520	11,789690
Hannan-Quinn criterion (HQC)	5,781219	8,523056	8,967522	10,443770	11,725930

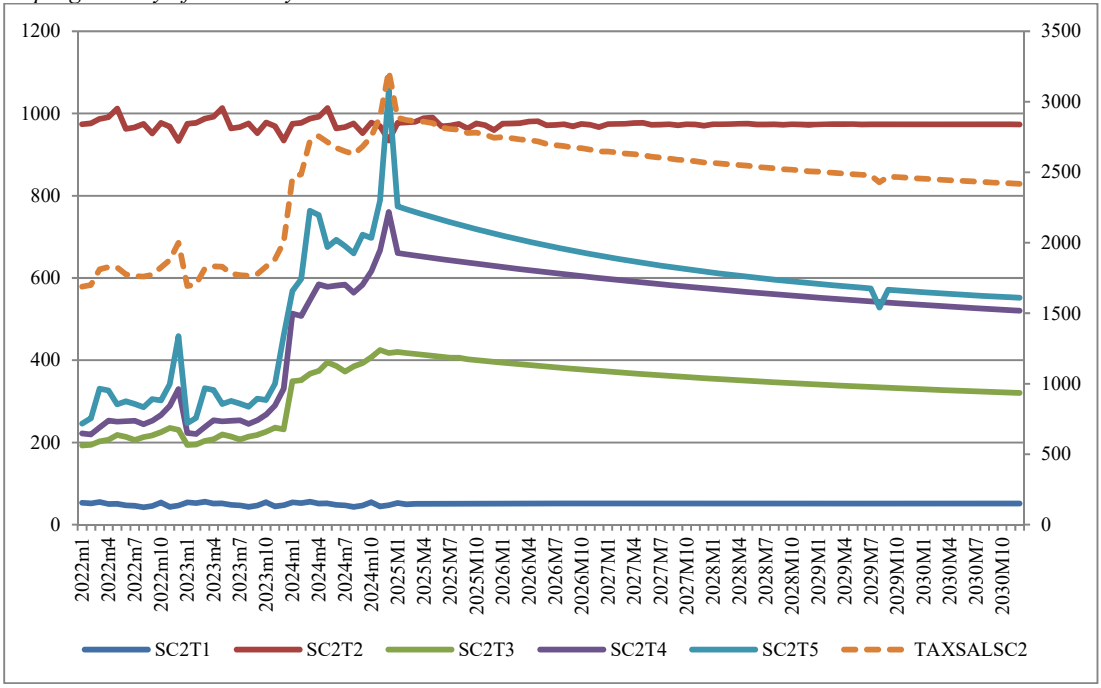
Source: author's calculations, initial NAFA data.

After choosing the model, in the diagnostic phase we will check if the residuals are white noise, then we will check if the roots are inside or outside the circles, for both MA and AR roots.

The roots of MA indicate whether the process is reversible and the roots of AR indicate that the process is stationary, so for both (AR and MA) they must be inside the circle (see Appendix).

If the roots AR and MA are inside the circle, we can perform the forecasting process. The synthetic forecast results are shown in the figure below (see Figure 1).

Figure no. 1. Forecast results according to scenario 2 with three rates: 10%, 18%, 23% of the progressivity of the salary tax



Source: author's calculations, initial NAFA data.

5. Conclusions

This article aims to develop a forecast model for the evolution of the payroll tax in Romania for the period 2025m1-2030m12. Using the ACF and PACF correlograms, we have identified a series of possible models for each salary income tranche; the placement on certain tranches is in accordance with NAFA data. Thus, three scenarios with 3 rates were developed, of which only one was chosen for the forecast, scenario 2, with the quotas of 10%, 18%, 23%, the most likely to be adopted in case the transition to fiscal progressivity is desired for salaries, even if it apparently brings the smallest benefits to the state budget. According to the Box-Jenkins methodology, for the payroll tax, the following models were selected for forecasting on the five tranches for scenario 2: ARMA(1,0,3); ARMA (12,0,7); ARMA (1, 0,0); ARMA (1,0,0); ARMA (1,0,0).

This type of forecasting model can help us understand the possible future evolutions of the salary tax, the personal income tax, including wealth and finally the way of reflection on the budget revenues and the budget deficit.

The article represents a partial capitalization of the study "Progressive taxation – theoretical and empirical analyses at the level of EU27 member countries" (coord. Ailincă, A.G.), of the 2023 annual research program of Centre for Financial and Monetary Research "Victor Slăvescu". At the same time, regarding the limits, the study presents an analysis on a limited time series, and only on a specific component: the salary tax. Thus, the study can be completed by extension, to be able to understand how it manifests itself on the budget deficit.

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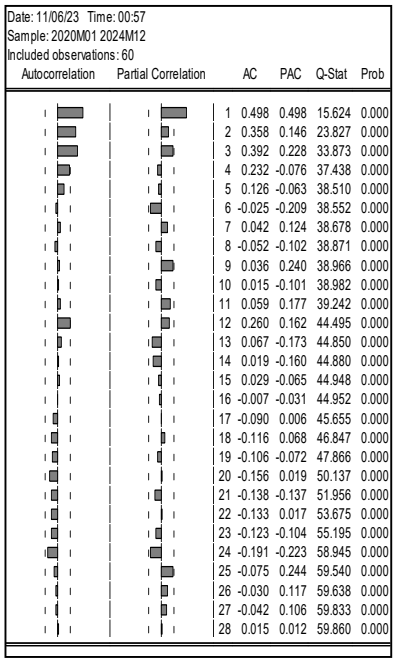
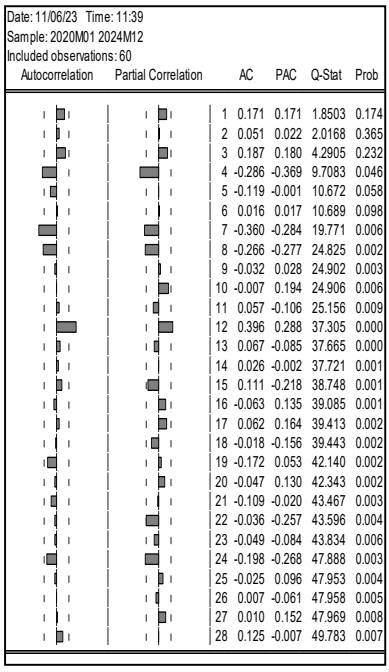
7. Annex



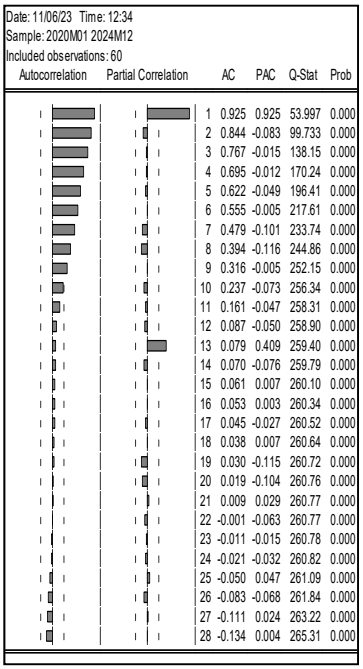
	AC	PAC	Q-Stat	Prob
1	0.498	0.498	15.624	0.000
2	0.358	0.146	23.827	0.000
3	0.392	0.228	33.873	0.000
4	0.232	-0.076	37.438	0.000
5	0.126	-0.063	38.510	0.000
6	-0.025	-0.209	38.552	0.000
7	0.042	0.124	38.678	0.000
8	-0.052	-0.102	38.871	0.000
9	0.036	0.240	38.966	0.000
10	0.015	-0.101	38.982	0.000
11	0.059	0.177	39.242	0.000
12	0.260	0.162	44.495	0.000
13	0.067	-0.173	44.850	0.000
14	0.019	-0.160	44.880	0.000
15	0.029	-0.065	44.948	0.000
16	-0.007	-0.031	44.952	0.000
17	-0.090	0.006	45.655	0.000
18	-0.116	0.068	46.847	0.000
19	-0.106	-0.072	47.866	0.000
20	-0.156	0.019	50.137	0.000
21	-0.138	-0.137	51.956	0.000
22	-0.133	0.017	53.675	0.000
23	-0.123	-0.104	55.195	0.000
24	-0.191	-0.223	58.945	0.000
25	-0.075	0.244	59.540	0.000
26	-0.030	0.117	59.638	0.000
27	-0.042	0.106	59.833	0.000
28	0.015	0.012	59.860	0.000

Correlogram for the SC2T1



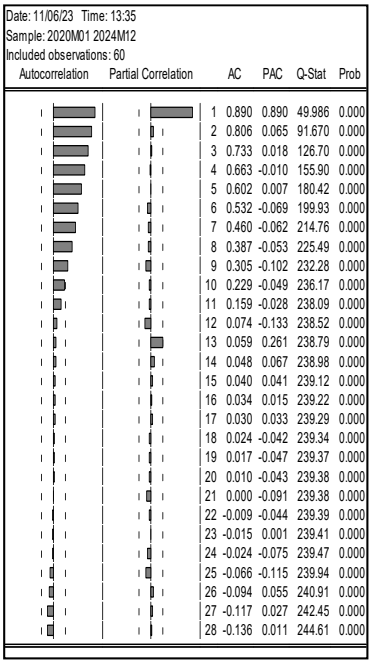
	AC	PAC	Q-Stat	Prob
1	0.171	0.171	1.8503	0.174
2	0.051	0.022	2.0168	0.365
3	0.187	0.180	4.2905	0.232
4	-0.286	-0.369	9.7083	0.046
5	-0.119	-0.001	10.672	0.058
6	0.016	0.017	10.689	0.098
7	-0.360	-0.284	19.771	0.006
8	-0.266	-0.277	24.825	0.002
9	-0.032	0.028	24.902	0.003
10	-0.007	0.194	24.906	0.006
11	0.057	-0.106	25.156	0.009
12	0.396	0.288	37.305	0.000
13	0.067	-0.085	37.665	0.000
14	0.026	-0.002	37.721	0.001
15	0.111	-0.218	38.748	0.001
16	-0.063	0.135	39.085	0.001
17	0.062	0.164	39.413	0.002
18	-0.018	-0.156	39.443	0.002
19	-0.172	0.053	42.140	0.002
20	-0.047	0.130	42.343	0.002
21	-0.109	-0.020	43.467	0.003
22	-0.036	-0.257	43.596	0.004
23	-0.049	-0.084	43.834	0.006
24	-0.198	-0.268	47.888	0.003
25	-0.025	0.096	47.953	0.004
26	0.007	-0.061	47.958	0.005
27	0.010	0.152	47.969	0.008
28	0.125	-0.007	49.783	0.007

Correlogram for the SC2T2



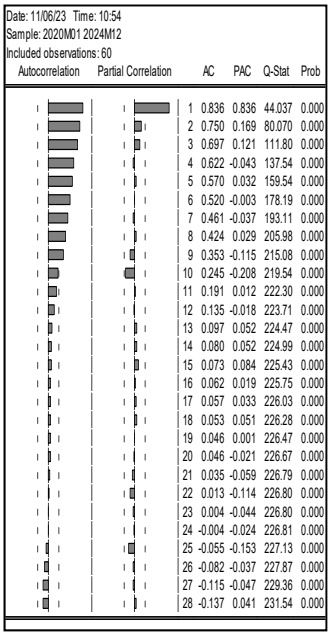
	AC	PAC	Q-Stat	Prob
1	0.925	0.925	53.997	0.000
2	0.844	-0.083	99.733	0.000
3	0.767	-0.015	138.15	0.000
4	0.695	-0.012	170.24	0.000
5	0.622	-0.049	196.41	0.000
6	0.555	-0.005	217.61	0.000
7	0.479	-0.101	233.74	0.000
8	0.394	-0.116	244.86	0.000
9	0.316	-0.005	252.15	0.000
10	0.237	-0.073	256.34	0.000
11	0.161	-0.047	258.31	0.000
12	0.087	-0.050	258.90	0.000
13	0.079	0.409	259.40	0.000
14	0.070	-0.076	259.79	0.000
15	0.061	0.007	260.10	0.000
16	0.053	0.003	260.34	0.000
17	0.045	-0.027	260.52	0.000
18	0.038	0.007	260.64	0.000
19	0.030	-0.115	260.72	0.000
20	0.019	-0.104	260.76	0.000
21	0.009	0.029	260.77	0.000
22	-0.001	-0.063	260.77	0.000
23	-0.011	-0.015	260.78	0.000
24	-0.021	-0.032	260.82	0.000
25	-0.050	0.047	261.09	0.000
26	-0.083	-0.068	261.84	0.000
27	-0.111	0.024	263.22	0.000
28	-0.134	0.004	265.31	0.000

Correlogram for the SC2T3



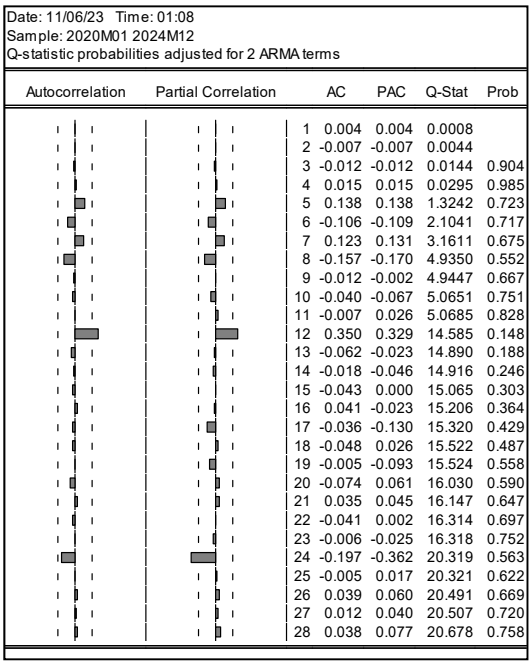
	AC	PAC	Q-Stat	Prob
1	0.890	0.890	49.986	0.000
2	0.806	0.065	91.670	0.000
3	0.733	0.018	126.70	0.000
4	0.663	-0.010	155.90	0.000
5	0.602	0.007	180.42	0.000
6	0.532	-0.069	199.93	0.000
7	0.460	-0.062	214.76	0.000
8	0.387	-0.053	225.49	0.000
9	0.305	-0.102	232.28	0.000
10	0.229	-0.049	236.17	0.000
11	0.159	-0.028	238.09	0.000
12	0.074	-0.133	238.52	0.000
13	0.059	0.261	238.79	0.000
14	0.048	0.067	238.98	0.000
15	0.040	0.041	239.12	0.000
16	0.034	0.015	239.22	0.000
17	0.030	0.033	239.29	0.000
18	0.024	-0.042	239.34	0.000
19	0.017	-0.047	239.37	0.000
20	0.010	-0.043	239.38	0.000
21	0.000	-0.091	239.38	0.000
22	-0.009	-0.044	239.39	0.000
23	-0.015	0.001	239.41	0.000
24	-0.024	-0.075	239.47	0.000
25	-0.066	-0.115	239.94	0.000
26	-0.094	0.055	240.91	0.000
27	-0.117	0.027	242.45	0.000
28	-0.136	0.011	244.61	0.000

Correlogram for the SC2T4



	AC	PAC	Q-Stat	Prob
1	0.836	0.836	44.037	0.000
2	0.750	0.169	80.070	0.000
3	0.697	0.121	111.80	0.000
4	0.622	-0.043	137.54	0.000
5	0.570	0.032	159.54	0.000
6	0.520	-0.003	178.19	0.000
7	0.461	-0.037	193.11	0.000
8	0.424	0.029	205.98	0.000
9	0.353	-0.115	215.08	0.000
10	0.245	-0.208	219.54	0.000
11	0.191	0.012	222.30	0.000
12	0.135	-0.018	223.71	0.000
13	0.097	0.052	224.47	0.000
14	0.080	0.052	224.99	0.000
15	0.073	0.084	225.43	0.000
16	0.062	0.019	225.75	0.000
17	0.057	0.033	226.03	0.000
18	0.053	0.051	226.28	0.000
19	0.046	0.001	226.47	0.000
20	0.046	-0.021	226.67	0.000
21	0.035	-0.059	226.79	0.000
22	0.013	-0.114	226.80	0.000
23	0.004	-0.044	226.80	0.000
24	-0.004	-0.024	226.81	0.000
25	-0.055	-0.153	227.13	0.000
26	-0.082	-0.037	227.87	0.000
27	-0.115	-0.047	229.36	0.000
28	-0.137	0.041	231.54	0.000

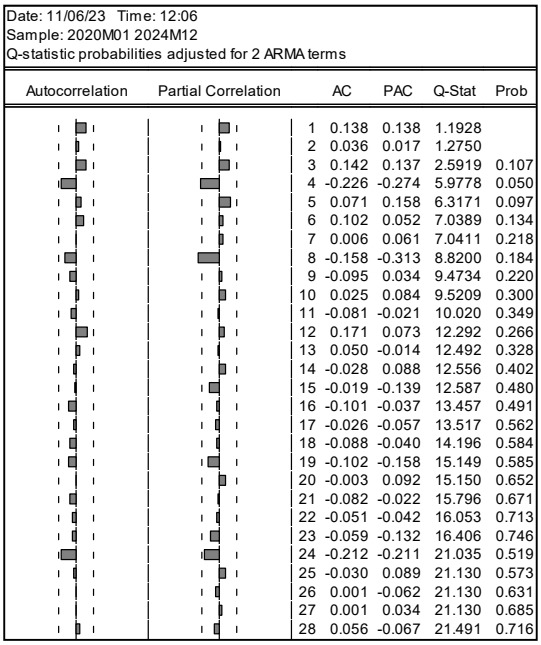
Correlogram for the SC2T5



Date: 11/06/23 Time: 01:08
Sample: 2020M01 2024M12
Q-statistic probabilities adjusted for 2 ARMA terms

	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1				0.004	0.004	0.0008	
2				-0.007	-0.007	0.0044	
3				-0.012	-0.012	0.0144	0.904
4				0.015	0.015	0.0295	0.985
5				0.138	0.138	1.3242	0.723
6				-0.106	-0.109	2.1041	0.717
7				0.123	0.131	3.1611	0.675
8				-0.157	-0.170	4.9350	0.552
9				-0.012	-0.002	4.9447	0.667
10				-0.040	-0.067	5.0651	0.751
11				-0.007	0.026	5.0685	0.828
12				0.350	0.329	14.585	0.148
13				-0.062	-0.023	14.890	0.188
14				-0.018	-0.046	14.916	0.246
15				-0.043	0.000	15.065	0.303
16				0.041	-0.023	15.206	0.364
17				-0.036	-0.130	15.320	0.429
18				-0.048	0.026	15.522	0.487
19				-0.005	-0.093	15.524	0.558
20				-0.074	0.061	16.030	0.590
21				0.035	0.045	16.147	0.647
22				-0.041	0.002	16.314	0.697
23				-0.006	-0.025	16.318	0.752
24				-0.197	-0.362	20.319	0.563
25				-0.005	0.017	20.321	0.622
26				0.039	0.060	20.491	0.669
27				0.012	0.040	20.507	0.720
28				0.038	0.077	20.678	0.758

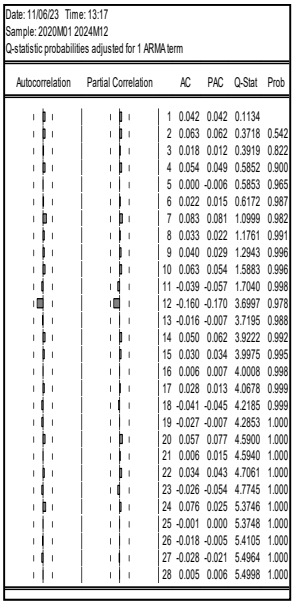
Residual correlogram selected model for the SC2T1



Date: 11/06/23 Time: 12:06
Sample: 2020M01 2024M12
Q-statistic probabilities adjusted for 2 ARMA terms

	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1				0.138	0.138	1.1928	
2				0.036	0.017	1.2750	
3				0.142	0.137	2.5919	0.107
4				-0.226	-0.274	5.9778	0.050
5				0.071	0.158	6.3171	0.097
6				0.102	0.052	7.0389	0.134
7				0.006	0.061	7.0411	0.218
8				-0.158	-0.313	8.8200	0.184
9				-0.095	0.034	9.4734	0.220
10				0.025	0.084	9.5209	0.300
11				-0.081	-0.021	10.020	0.349
12				0.171	0.073	12.292	0.266
13				0.050	-0.014	12.492	0.328
14				-0.028	0.088	12.556	0.402
15				-0.019	-0.139	12.587	0.480
16				-0.101	-0.037	13.457	0.491
17				-0.026	-0.057	13.517	0.562
18				-0.088	-0.040	14.196	0.584
19				-0.102	-0.158	15.149	0.585
20				-0.003	0.092	15.150	0.652
21				-0.082	-0.022	15.796	0.671
22				-0.051	-0.042	16.053	0.713
23				-0.059	-0.132	16.406	0.746
24				-0.212	-0.211	21.035	0.519
25				-0.030	0.089	21.130	0.573
26				0.001	-0.062	21.130	0.631
27				0.001	0.034	21.130	0.685
28				0.056	-0.067	21.491	0.716

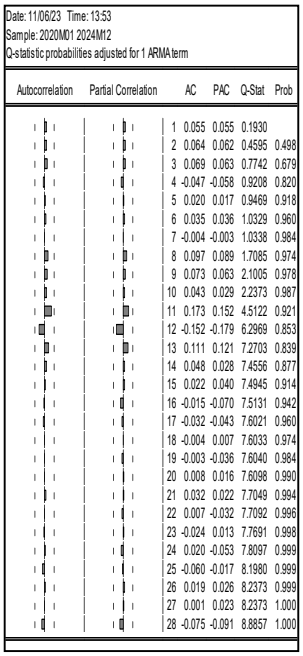
Residual correlogram selected model for the SC2T2



Date: 11/06/23 Time: 13:17
Sample: 2020M01 2024M12
Q-statistic probabilities adjusted for 1 ARMA term

	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1				0.042	0.042	0.1134	
2				0.063	0.062	0.3718	0.542
3				0.018	0.012	0.3919	0.822
4				0.054	0.049	0.5852	0.900
5				0.000	-0.006	0.5853	0.965
6				0.022	0.015	0.6172	0.987
7				0.083	0.081	1.0999	0.982
8				0.033	0.022	1.1761	0.991
9				0.040	0.029	1.2943	0.996
10				0.063	0.054	1.5883	0.996
11				-0.039	-0.057	1.7040	0.998
12				-0.160	-0.170	3.6997	0.978
13				-0.016	-0.007	3.7195	0.988
14				0.050	0.062	3.9222	0.992
15				0.030	0.034	3.9975	0.995
16				0.006	0.007	4.0008	0.998
17				0.028	0.013	4.0678	0.999
18				-0.041	-0.045	4.2185	0.999
19				-0.027	-0.007	4.2853	1.000
20				0.057	0.077	4.5900	1.000
21				0.006	0.015	4.5940	1.000
22				0.034	0.043	4.7061	1.000
23				-0.026	-0.054	4.7745	1.000
24				0.076	0.025	5.3746	1.000
25				-0.001	0.000	5.3748	1.000
26				-0.018	-0.005	5.4105	1.000
27				-0.028	-0.021	5.4964	1.000
28				0.005	0.006	5.4998	1.000

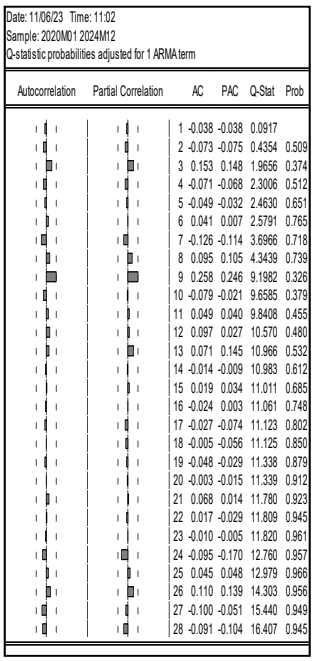
Residual correlogram selected model for the SC2T3



Date: 11/06/23 Time: 13:53
Sample: 2020M01 2024M12
Q-statistic probabilities adjusted for 1 ARMA term

	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1				0.055	0.055	0.1930	
2				0.064	0.062	0.4595	0.498
3				0.069	0.063	0.7742	0.679
4				-0.047	-0.058	0.9208	0.820
5				0.020	0.017	0.9469	0.918
6				0.035	0.036	1.0329	0.960
7				-0.004	-0.003	1.0338	0.984
8				0.097	0.089	1.7085	0.974
9				0.073	0.063	2.1005	0.978
10				0.043	0.029	2.2373	0.987
11				0.173	0.152	4.5122	0.921
12				-0.152	-0.179	6.2969	0.853
13				0.111	0.121	7.2703	0.839
14				0.048	0.028	7.4556	0.877
15				0.022	0.040	7.4945	0.914
16				-0.015	-0.070	7.5131	0.942
17				-0.032	-0.043	7.6021	0.960
18				-0.004	0.007	7.6033	0.974
19				-0.003	-0.036	7.6040	0.984
20				0.008	0.016	7.6098	0.990
21				0.032	0.022	7.7049	0.994
22				0.007	-0.032	7.7092	0.996
23				-0.024	0.013	7.7691	0.998
24				0.020	-0.053	7.8097	0.999
25				-0.060	-0.017	8.1980	0.999
26				0.019	0.026	8.2373	0.999
27				0.001	0.023	8.2373	1.000
28				-0.075	-0.091	8.8857	1.000

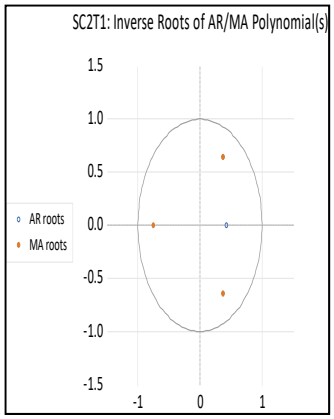
Residual correlogram selected model for the SC2T4



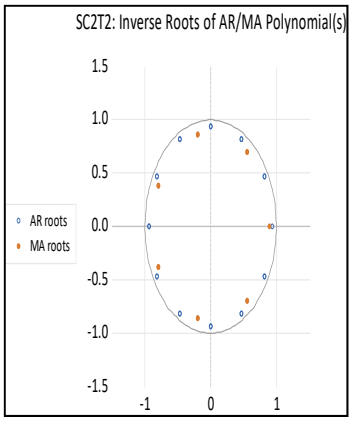
Date: 11/06/23 Time: 11:02
Sample: 2020M01 2024M12
Q-statistic probabilities adjusted for 1 ARMA term

	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1				-0.038	-0.038	0.0917	
2				-0.073	-0.075	0.4354	0.509
3				0.153	0.148	1.9656	0.374
4				-0.071	-0.068	2.3006	0.512
5				-0.049	-0.032	2.4630	0.651
6				0.041	0.007	2.5791	0.765
7				-0.126	-0.114	3.6966	0.718
8				0.095	0.105	4.3439	0.739
9				0.258	0.246	9.1982	0.326
10				-0.079	-0.021	9.6585	0.379
11				0.049	0.040	9.8408	0.455
12				0.097	0.027	10.570	0.480
13				0.071	0.145	10.966	0.532
14				-0.014	-0.009	10.983	0.612
15				0.019	0.034	11.011	0.685
16				-0.024	0.003	11.061	0.748
17				-0.027	-0.074	11.123	0.802
18				-0.005	-0.056	11.125	0.850
19				-0.048	-0.029	11.338	0.879
20				-0.003	-0.015	11.339	0.912
21				0.068	0.014	11.780	0.923
22				0.017	-0.029	11.809	0.945
23				-0.010	-0.005	11.820	0.961
24				-0.095	-0.170	12.760	0.957
25				0.045	0.048	12.979	0.966
26				0.110	0.139	14.303	0.956
27				-0.100	-0.051	15.440	0.949
28				-0.091	-0.104	16.407	0.945

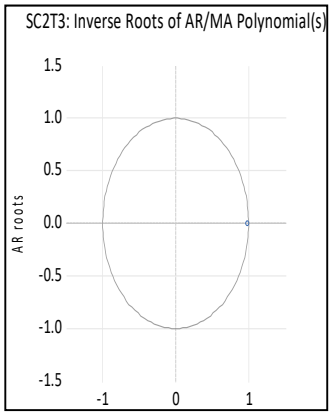
Residual correlogram selected model for the SC2T5



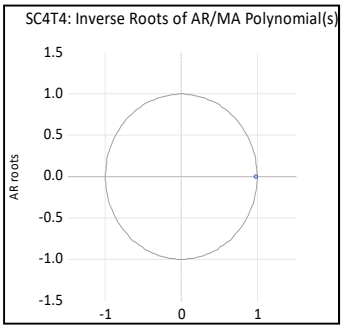
The structure of ARIMA roots according to the model chosen for SC2T1



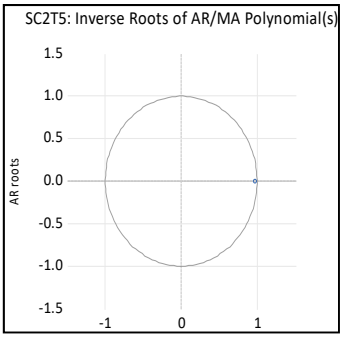
The structure of ARIMA roots according to the model chosen for SC2T2



The structure of ARIMA roots according to the model chosen for SC2T3



The structure of ARIMA roots according to the model chosen for SC2T4



The structure of ARIMA roots according to the model chosen for SC2T5