Industry as a Pillar of the Mountain Economy. European Mountain Series Forecasting (4)

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Article

Industry as a Pillar of the Mountain Economy. European Mountain Series Forecasting (4)

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Abstract: This study analyzes the evolution of mountain entrepreneurship in Europe, focusing on industrial sectors, during the period 2021-2035. Using Eurostat data from 15 European countries, forecasting models (ARIMA and Holt) were applied to assess trends and project future developments. The results indicate an initial moderate growth (2.5% per year), supported by sustainable tourism policies and investments in mountain infrastructure, followed by an acceleration of growth (4% per year) between 2026 and 2030, driven by digitalization, activity diversification, and European funds. By 2035, the sector will reach a stable maturity (3% per year), based on automation, adaptation to climate change, and cross-border collaborations. Regional disparities remain, with Western Europe surpassing Eastern Europe due to better access to funds and reduced administrative barriers. The study emphasizes the importance of sustainability and digital transformation for the sustainable development of mountain entrepreneurship in industrial sectors.

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Introduction and Literature Review

This research explores the interactions between human investments and the natural mountain environment, including protected areas such as nature reserves, national parks, and landscape parks, with the aim of developing a sustainable mountain policy. According to the principles proposed by Rey (1997), the development of mountain regions must be integrated into a coherent European strategy that ensures the efficient coordination of sectoral policies, respects local and regional autonomy, and facilitates intercommunal and cross-border cooperation. The author proposes the creation of a flexible system that connects urban expansion areas through green corridors made up of settlements, mountain recreation areas, parks, forests, and agricultural land. This system aims to maintain a balance between urban development and the conservation of the natural environment, recognizing the identity and specificity of the mountain area, in line with the principles of sustainable development. To ensure sustainable economic development and job creation, it is essential to support and maintain small, non-polluting industries by improving mountain infrastructure and simplifying administrative and fiscal procedures. Initiatives in rural tourism and agrotourism should be promoted, considering the need to protect the natural and social mountain environment. Economic activities must be diversified to prevent the over-exploitation of mountain natural resources, thus maintaining ecological balance. Mountain areas must be equipped with infrastructure, equipment, and services that support a stable population, using technologies adapted to the mountain environment and environmentally friendly. In the energy sector, the utilization of local resources,

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such as hydroelectric potential, alternative and renewable energies, as well as improving heating systems through the efficient use of wood waste and other secondary resources, becomes essential for sustainable development. The main outcome of the research is the development of a model for development based on the configuration of river and road networks, which can be implemented in future regional plans, thus contributing to establishing a balance between human development and the protection of the mountain environment. This model has the potential to support the implementation of a coherent framework for the sustainable development of mountain regions, while simultaneously protecting natural landscapes and biodiversity. (Rey, 1997)

In recent decades, many European mountain regions have witnessed a profound process of economic restructuring, which has led to the decline of traditional heavy industry and the manufacturing sector. This change has had a significant impact on peripheral and rural regions, and the conversion of abandoned industrial lands has become a key issue for their sustainable development, even though the official recognition of this issue is still limited. The complex ecological, economic, and social challenges raised by the conversion of industrial lands in mountain areas, combined with the structural peculiarities of marginal contexts, require the development of a specific strategy, but adaptable to various mountain regions. The Alps, being the most developed mountain region in Europe, have the potential to become a laboratory for testing and implementing strategies for the conversion of abandoned industrial lands. Preliminary research results suggest that an effective and transferable transformation approach can be achieved through the application of a "landscape approach" based on structuralist planning principles. These principles can contribute to the development of a conversion strategy that transforms abandoned industrial lands into valuable territorial infrastructures capable of supporting the regeneration of mountain regions, rather than remaining vacant lands designated exclusively for conversion. (Modica & Weilacher, 2019).

In a polarized economic context, where the emergence of successful economic clusters contrasts with the decline of traditional industrial activities, the conversion of abandoned industrial lands becomes a strategically essential issue both at local and regional levels, especially in mountain regions. However, in the alpine context, the transformation and reuse of these decommissioned industrial sites face additional challenges related to continuously changing economic conditions and the emerging new paradigms of territorial development. In this context, the long-term sustainability of mountain economies depends on the ability to overcome traditional mono-structural economic models through the innovative and integrated use of existing territorial capital. The concept of territorial capital – which includes biophysical factors, environmental conditions, and socio-cultural capacities of a territory – is essential in this process. It requires a shift in perception, where the natural and human resources of the region are valued for the purpose of creating a sustainable economic future. A productive use of abandoned industrial lands can include a wide range of programmatic options, from business parks and innovative business incubators to centers for cultural and artistic production, thus contributing to the diversification of mountain tourism through an expanded cultural offering. (Modica, 2022)

Some authors believe that in certain areas of the world, deindustrialization must be replaced by mountain tourism. Sustainability and the management of tourism's impact on the mountain environment are key topics in this case. However, the pandemic period, such as SARS CoV-2 COVID-19, highlighted the vulnerabilities of the mountain tourism sector, amplifying the need for resilient and flexible strategies. In addition, the concept of the experience economy is discussed, where visitors seek not only basic services but also authentic and personalized experiences, performance management, dynamic pricing policies, and investment management, all contributing to the continued success of mountain resorts. (Solelhac, 2021)

In the alpine context, other researchers believe that the interactions between human investments and the natural forms of the mountain environment, such as nature reserves, national parks, and landscape parks, can solve the reindustrialization problem through creative industries. The model proposed by these researchers aims to integrate urban expansion into a natural framework by creating ecological belts composed of settlements, mountain recreation areas, parks, forests, and

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agricultural land. The central idea was to ensure the harmonious coexistence of different land functions while maintaining a balance between urban development and the protection of the mountain environment. This development model aims to avoid the fragmentation of the mountain landscape and promote urbanization that respects the ecological specificity of the region. (Zareba & Krzeminska, 2010)

Methodology

This study explores the role of industrial entrepreneurship in the context of mountain economies across Europe.

For the analysis presented in this article, data collected from official Eurostat sources concerning the mountain regions of Europe were used, including Austria, Bulgaria, Croatia, the Czech Republic, France, Germany, Greece, Italy, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. These data are structured into 28 indicators (I1-I28) for the analysis and forecast period 2021-2035, with each indicator being associated with distinct economic models (Table 1) (detailed explanations of the indicators are available through the authors at the link https://doi.org/10.5281/zenodo.14713867). For example, I1.2021 corresponds to Model_1, and I1.2022 corresponds to Model_2. Each indicator reflects the economic developments and trends within the entrepreneurial sector of the mountain industry in these countries.

The targeted indicators are specific to the mountain economy, including data on entrepreneurial activities in industrial sectors such as industrial production, small and medium enterprises (SMEs), infrastructure investments, and other aspects relevant to the sustainable development of the mountain industry.

Table 1. Model Forecast Statistics.

Model	Stationary R-squared	R-squared	RMSE	MAPE	MAE	MaxAPE	MaxAE	Normalized BIC
I1.2021-Model_1	2.220E-16	2.220E-16	53512.539	410.551	37124.816	4001.255	146901.143	21.964
I1.2022-Model_2	2.220E-16	2.220E-16	53373.319	473.371	37629.745	4896.578	146220.643	21.959
I2.2021-Model_3	1.110E-16	1.110E-16	2855.529	475.876	2141.551	5238.903	6700.214	16.103
I2.2022-Model_4	0.000	0.000	2870.759	526.423	2231.286	5937.255	6338.000	16.113
I3.2021-Model_5	1.332E-15	1.332E-15	0.604	36.010	0.470	104.225	1.240	-0.803
I3.2022-Model_6	0.000	0.000	0.496	39.831	0.415	134.195	0.778	-1.195
I4.2021-Model_7			0.000	0.000	0.000	0.000	0.000	
I4.2022-Model_8			0.000	0.000	0.000	0.000	0.000	
I5.2021-Model_9	0.000	0.000	2575.481	776.120	1884.994	8324.615	6736.615	15.905
I5.2022-Model_10	2.220E-16	2.220E-16	2713.581	694.858	2074.414	7469.636	6517.538	16.009
I6.2021-Model_11	0.000	0.000	64.512	255.148	39.552	1185.203	182.705	8.552
I6.2022-Model_12	0.000	0.000	61.427	516.093	37.934	4076.364	172.418	8.454

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I7.2021-Model_13	0.476	0.476	1401.245	184.267	1094.184	1102.151	2771.294	14.885
I7.2022-Model_14	0.000	0.000	2035.800	643.814	1618.661	5505.981	4264.727	15.455
I8.2021-Model_15	1.221E-15	1.221E-15	1.837	38.846	1.583	102.929	3.280	1.414
I8.2022-Model_16	1.110E-15	1.110E-15	1.678	33.251	1.348	133.062	2.821	1.254
I10.2021-Model_17	0.000	0.000	460.679	236.278	250.852	2070.085	1465.385	12.463
I10.2022-Model_18	0.000	0.000	577.747	309.357	323.100	2052.778	1615.500	12.949
I12.2021-Model_19	1.110E-15	1.110E-15	4.669	30.863	3.587	83.863	9.152	3.279
I12.2022-Model_20	-2.442E-15	-2.442E-15	5.608	35.869	4.708	72.614	7.616	3.666
I13.2021-Model_21	2.109E-15	2.109E-15	2.779	32.375	2.066	77.972	6.711	2.241
I13.2022-Model_22	2.331E-15	2.331E-15	2.562	29.418	1.955	87.342	5.019	2.099
I14.2021-Model_23	-2.442E-15	-2.442E-15	2.229	34.263	1.695	133.658	5.058	1.800
I14.2022-Model_24	1.887E-15	1.887E-15	3.718	45.678	2.932	96.930	7.086	2.844
I15.2021-Model_25	1.110E-16	1.110E-16	6.115	155.923	3.719	923.611	17.474	3.828
I15.2022-Model_26	1.110E-16	1.110E-16	6.115	155.923	3.719	923.611	17.474	3.828
I16.2021-Model_27	-2.220E-16	-2.220E-16	607177.035	959.081	437344.125	9633.142	1406132.250	26.840
I16.2022-Model_28	1.110E-16	1.110E-16	612200.047	935.196	416188.611	9451.229	1437255.833	26.857
I17.2021-Model_29	0.000	0.000	3482.545	669.528	2449.611	6957.778	8862.333	16.518
I18.2021-Model_30	2.998E-15	2.998E-15	0.351	28.609	0.280	73.939	0.522	-1.863
I18.2022-Model_31	-1.776E-15	-1.776E-15	0.554	39.767	0.404	99.464	1.293	-0.952
I19.2021-Model_32	1.110E-16	1.110E-16	4467.195	1261.917	3012.132	11994.545	11455.909	17.027
I19.2022-Model_33	0.000	0.000	6025.749	1847.049	3878.741	15663.492	14742.778	17.652
I20.2021-Model_34	2.220E-16	2.220E-16	6316.157	433.367	3618.486	4141.012	18513.583	17.709
I20.2022-Model_35	-2.220E-16	-2.220E-16	6300.247	1283.167	3617.181	14171.458	18519.417	17.704
I21.2021-Model_36	0.000	0.000	3086.549	300.302	2089.514	2401.156	8141.417	16.277
I21.2022-Model_37	0.000	0.000	3462.888	1027.351	2317.940	9131.842	8540.900	16.530

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I22.2021-Model_38	8.882E-16	8.882E-16	0.564	51.857	0.440	124.651	1.214	-0.916
I22.2022-Model_39	-6.661E-16	-6.661E-16	0.632	57.538	0.574	112.618	0.796	-0.674
I23.2021-Model_40	2.220E-15	2.220E-15	0.694	62.114	0.562	333.506	1.167	-0.513
I23.2022-Model_41	2.220E-16	2.220E-16	0.485	47.953	0.377	244.156	0.855	-1.228
I24.2021-Model_42	-0.066	0.246	33.854	154.331	26.987	1233.983	55.603	7.251
I24.2022-Model_43	0.852	0.325	28.859	79.821	23.509	552.470	44.761	7.139
I25.2021-Model_44	1.110E-16	1.110E-16	576619.430	1079.848	436447.521	10025.736	1215095.455	26.748
I25.2022-Model_45	0.000	0.000	582961.784	1026.026	413287.471	9548.053	1254080.545	26.770
I26.2021-Model_46	0.000	0.000	2233.096	994.509	1785.320	8267.083	4796.900	15.653
I27.2021-Model_47	2.220E-16	2.220E-16	2864.595	2724.302	2168.280	23404.000	5503.600	16.151
I27.2022-Model_48	0.000	0.000	3191.451	1859.566	2017.407	14456.349	8133.111	16.381
I28.2021-Model_49	1.998E-15	1.998E-15	22.674	73.220	18.276	297.552	34.278	6.473
I28.2022-Model_50	-4.441E-16	-4.441E-16	23.652	89.175	20.986	278.498	32.083	6.557

Before applying statistical models, the data underwent a rigorous processing process:

- managing missing data: missing values were identified and addressed through imputation or elimination, depending on the nature and severity of data absences, to ensure consistency and accuracy in the analysis;

- detecting outliers: to ensure the integrity of the datasets, extreme values were detected and managed using appropriate statistical techniques (such as Z-scores and boxplot diagrams), and outliers were excluded from the final analysis;

- data normalization: the values of the indicators were normalized to make data from different sources and with varying measurement scales comparable. This step was crucial to ensure uniform analysis of data from various European countries.

The analysis was conducted using several statistical models, selected based on the typology of each indicator and the economic relationships being analyzed (Table 2):

Table 2. Model Parameters.

Arima Model Parameters					
Model	**Transformation**	**Estimate**	**SE**	**t**	**Sig.**
I1.2021-Model_1	Constant	48558.857	14301.828	3.395	0.005
I1.2022-Model_2	Constant	49116.357	14264.620	3.443	0.004
I2.2021-Model_3	Constant	2989.786	763.172	3.918	0.002
I2.2022-Model_4	Constant	3079.000	767.243	4.013	0.001
I3.2021-Model_5	Constant	1.450	0.174	8.323	0.000
I3.2022-Model_6	Constant	1.358	0.143	9.486	0.000
I4.2021-Model_7	Constant	1.000	0.000		

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I4.2022-Model_8	Constant	1.000	0.000		
I5.2021-Model_9	Constant	2527.385	714.310	3.538	0.004
I5.2022-Model_10	Constant	2876.462	752.612	3.822	0.002
I6.2021-Model_11	Constant	47.295	19.451	2.431	0.035
I6.2022-Model_12	Constant	43.852	18.521	2.368	0.039
I7.2021-Model_13	Constant	2072.089	235.791	8.788	0.000
	AR	-0.703	0.214	-3.290	0.007
I7.2022-Model_14	Constant	2130.273	613.817	3.471	0.006
I8.2021-Model_15	Constant	4.850	0.510	9.519	0.000
I8.2022-Model_16	Constant	4.941	0.506	9.763	0.000
I10.2021-Model_17	Constant	390.615	127.769	3.057	0.010
I10.2022-Model_18	Constant	387.500	182.700	2.121	0.063
I12.2021-Model_19	Constant	13.348	1.295	10.309	0.000
I12.2022-Model_20	Constant	15.294	1.691	9.045	0.000
I13.2021-Model_21	Constant	7.439	0.771	9.652	0.000
I13.2022-Model_22	Constant	7.831	0.772	10.139	0.000
I14.2021-Model_23	Constant	5.912	0.618	9.563	0.000
I14.2022-Model_24	Constant	7.464	1.121	6.659	0.000
I15.2021-Model_25	Constant	0.494	1.765	0.280	0.785
I15.2022-Model_26	Constant	0.494	1.765	0.280	0.785
I16.2021-Model_27	Constant	573184.750	175277.023	3.270	0.007
I16.2022-Model_28	Constant	560657.167	176726.991	3.172	0.009
I17.2021-Model_29	Constant	4234.667	1005.324	4.212	0.001
I18.2021-Model_30	Constant	1.148	0.111	10.338	0.000
I18.2022-Model_31	Constant	1.117	0.175	6.378	0.000
I19.2021-Model_32	Constant	4233.091	1346.910	3.143	0.010
I19.2022-Model_33	Constant	5517.222	2008.583	2.747	0.025
I20.2021-Model_34	Constant	5937.417	1823.317	3.256	0.008
I20.2022-Model_35	Constant	5708.583	1818.725	3.139	0.009
I21.2021-Model_36	Constant	3426.583	891.010	3.846	0.003
I21.2022-Model_37	Constant	3508.100	1095.061	3.204	0.011
I22.2021-Model_38	Constant	0.966	0.178	5.417	0.000
I22.2022-Model_39	Constant	1.254	0.211	5.956	0.000
I23.2021-Model_40	Constant	1.517	0.209	7.252	0.000
I23.2022-Model_41	Constant	1.205	0.146	8.232	0.000
I25.2021-Model_44	Constant	530588.545	173857.374	3.052	0.012
I25.2022-Model_45	Constant	515495.455	175769.564	2.933	0.015
I26.2021-Model_46	Constant	2008.100	706.167	2.844	0.019
I27.2021-Model_47	Constant	2350.400	905.865	2.595	0.029
I27.2022-Model_48	Constant	2037.889	1063.817	1.916	0.092
I28.2021-Model_49	Constant	45.798	7.170	6.387	0.000
I28.2022-Model_50	Constant	43.603	7.479	5.830	0.000

Exponential Smoothing Model Parameters

Model	Transformation	Estimate	SE	t	Sig.
I24.2021-Model_42	Alpha (Level)	0.731	0.287	2.545	0.027
I24.2022-Model_43	Alpha (Level)	0.100	0.104	0.963	0.358
	Gamma (Trend)	2.336E-05	0.129	0.000	1.000

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- time series forecasting models: for indicators that exhibit clear temporal dependencies, ARIMA (0,0,0) (AutoRegressive Integrated Moving Average) models were used (with the exceptions described later). For example, Model_13 (I7.2021) was analyzed with ARIMA (1,0,0), a model suitable for forecasting economic indicators based on historical values from previous years;

- simple regression models: for indicators that had a linear relationship between variables, simple linear regression models were applied (for example, Model_43 for I24.2021) to explore economic links within the mountain industry, such as correlations between entrepreneurship and infrastructure development;

- Holt exponential smoothing method: for indicators exhibiting seasonal or long-term trends (such as for I24.2022 Model_44), the Holt model, an exponential smoothing technique, was applied, which is suitable for data that varies based on seasonality and economic trends.

To assess the effectiveness and accuracy of the applied models, several adjustment statistics were calculated, allowing comparison of their performance (figures in methodology):

- R-squared (R^2): this measures the proportion of variability in the dependent indicator explained by the applied models. Values closer to 1 indicate better explanation of economic variability within the mountain entrepreneurial sector;

- Stationary R-squared: a variant of R^2, used for time series models, measuring the adjustment of the model to stationary data;

- RMSE (Root Mean Square Error): this measures the errors between observed and predicted values by the models. A lower RMSE indicates greater accuracy in economic forecasts;

- MAPE (Mean Absolute Percentage Error): represents the average percentage error between the predicted and observed values, being an important accuracy indicator, with lower values indicating a more accurate forecast;

- MaxAPE (Maximum Absolute Percentage Error): measures the maximum absolute error in percentage form, useful for evaluating forecast extremes;

- MAE (Mean Absolute Error): the average of absolute differences between observed and predicted values, with lower values being desired;

- MaxAE (Maximum Absolute Error): represents the maximum absolute error between predicted and actual values, indicating possible large deviations in forecast models;

- Normalized BIC (Bayesian Information Criterion): used for comparing models, with smaller BIC values indicating a more efficient model.

The adjustment statistics and standard errors obtained for the entire range of models are as follows: - R-squared: Mean = 0.021, SE = 0.087; - Stationary R-squared: Mean = 0.025, SE = 0.137; - RMSE: Mean = 49025.819, SE = 159457.822; - MAPE: Mean = 597.758, SE = 1008.063; - MaxAPE: Mean = 5084.278, SE = 7647.604; - MAE: Mean = 35023.827, SE = 114180.199; - MaxAE: Mean = 110834.493, SE = 356946.139; - Normalized BIC: Mean = 10.676, SE = 8.711.

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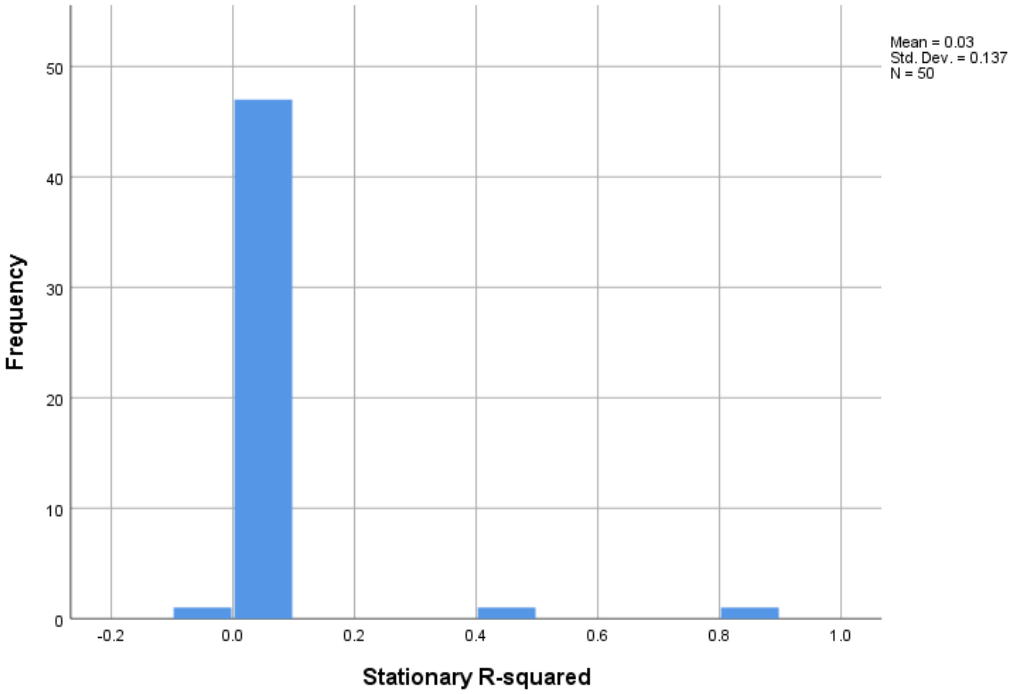

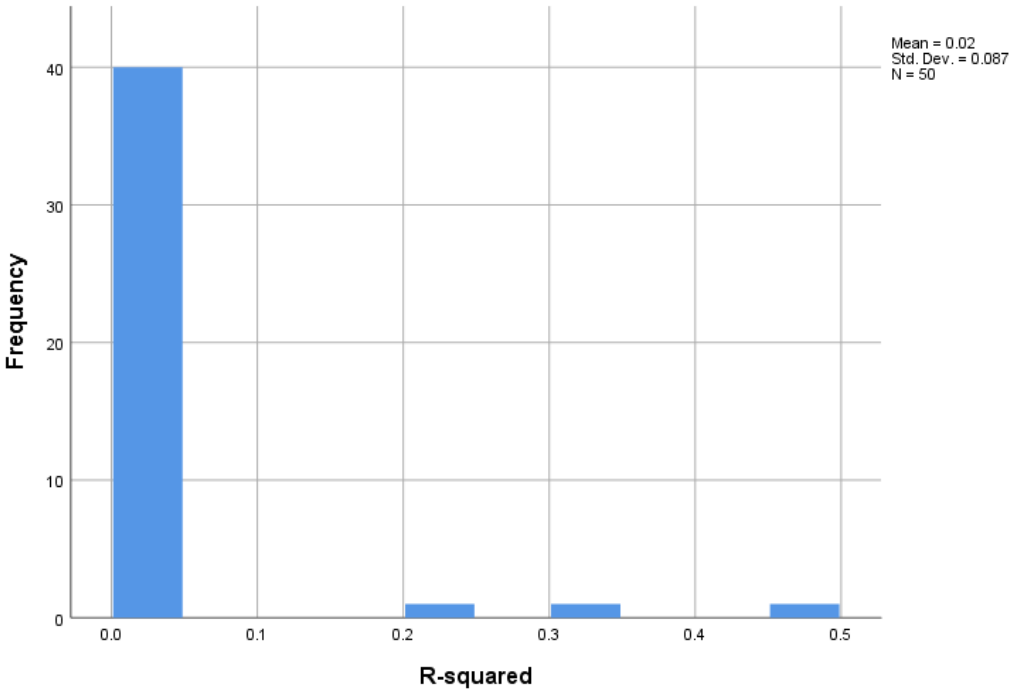

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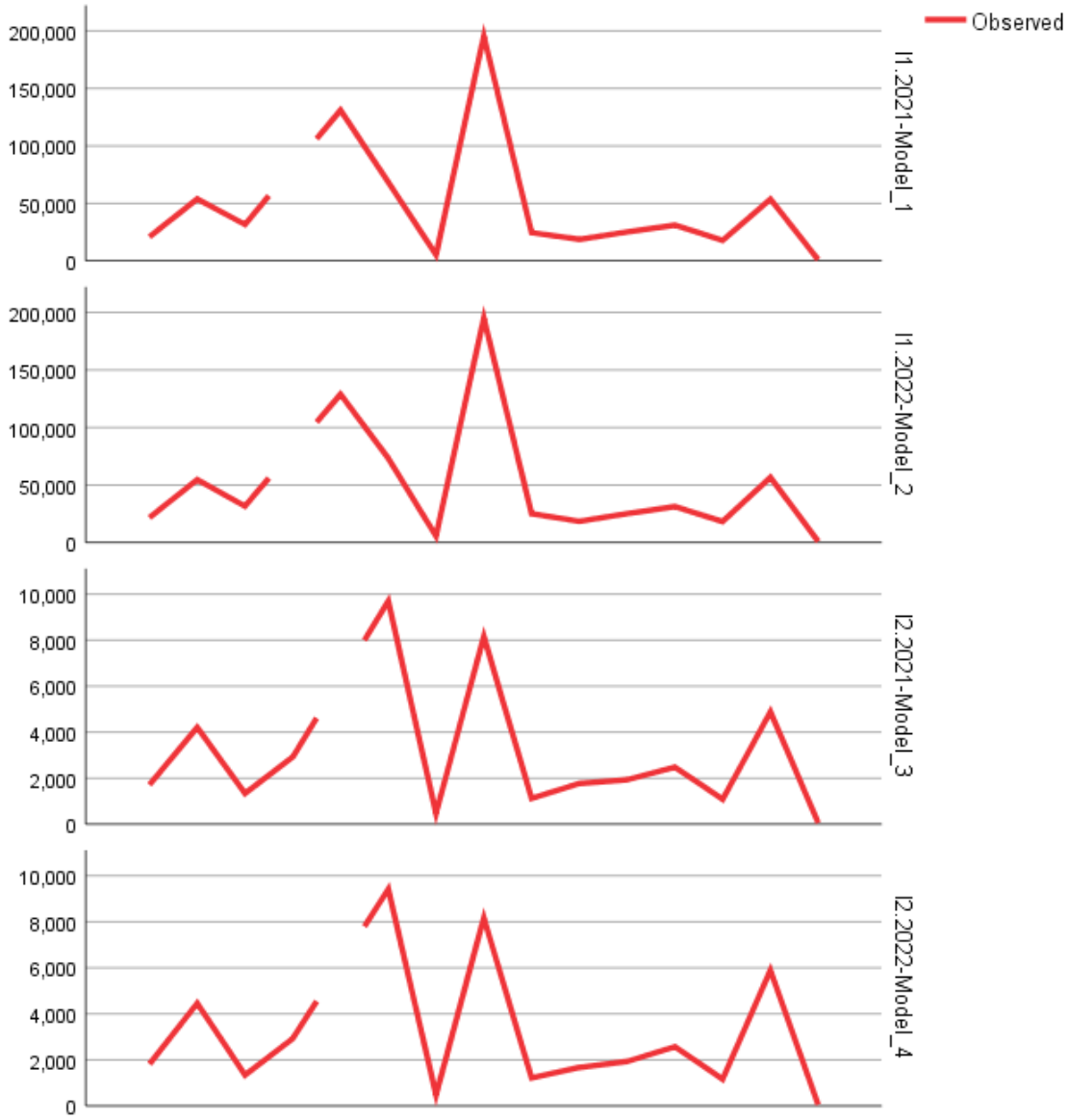

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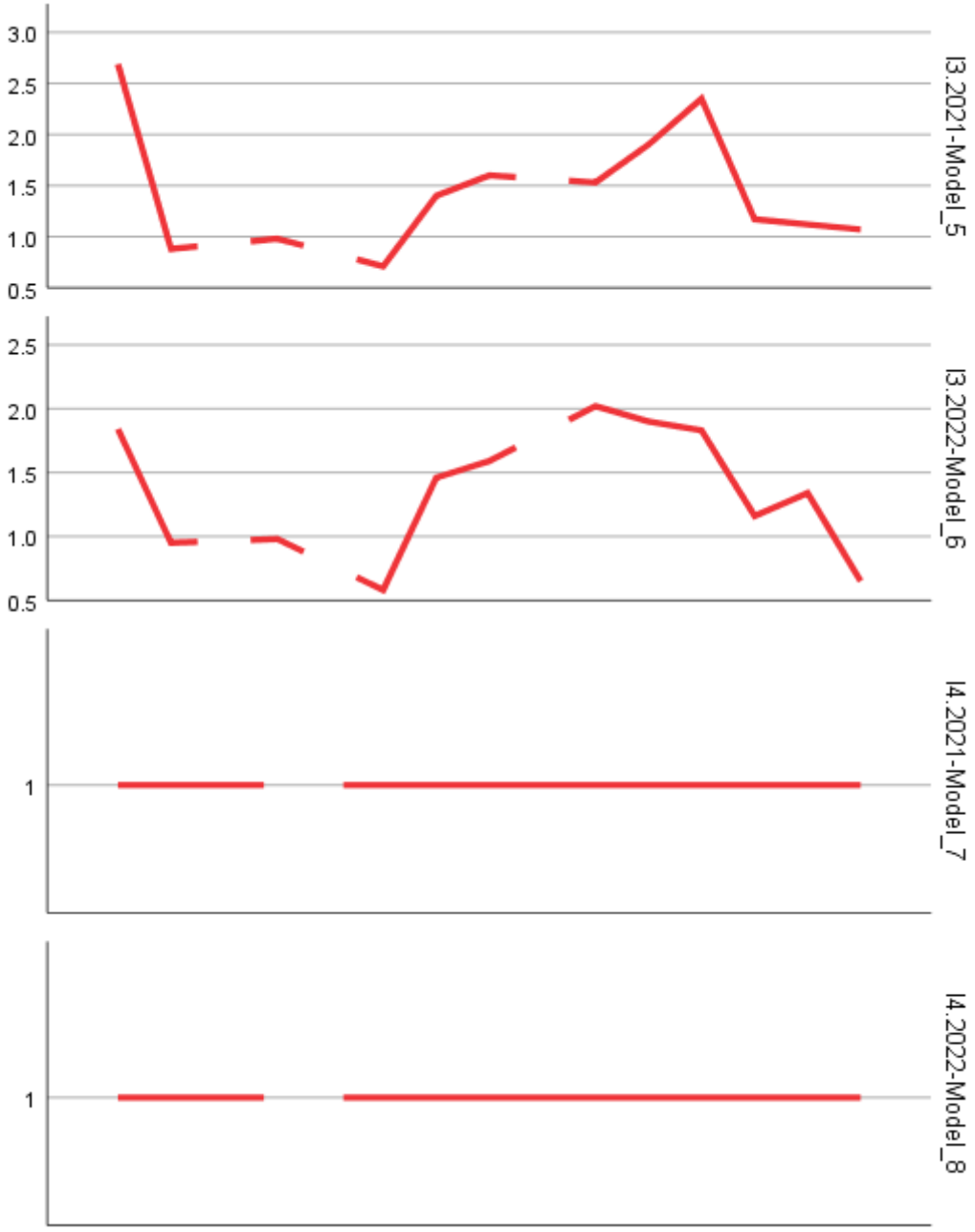

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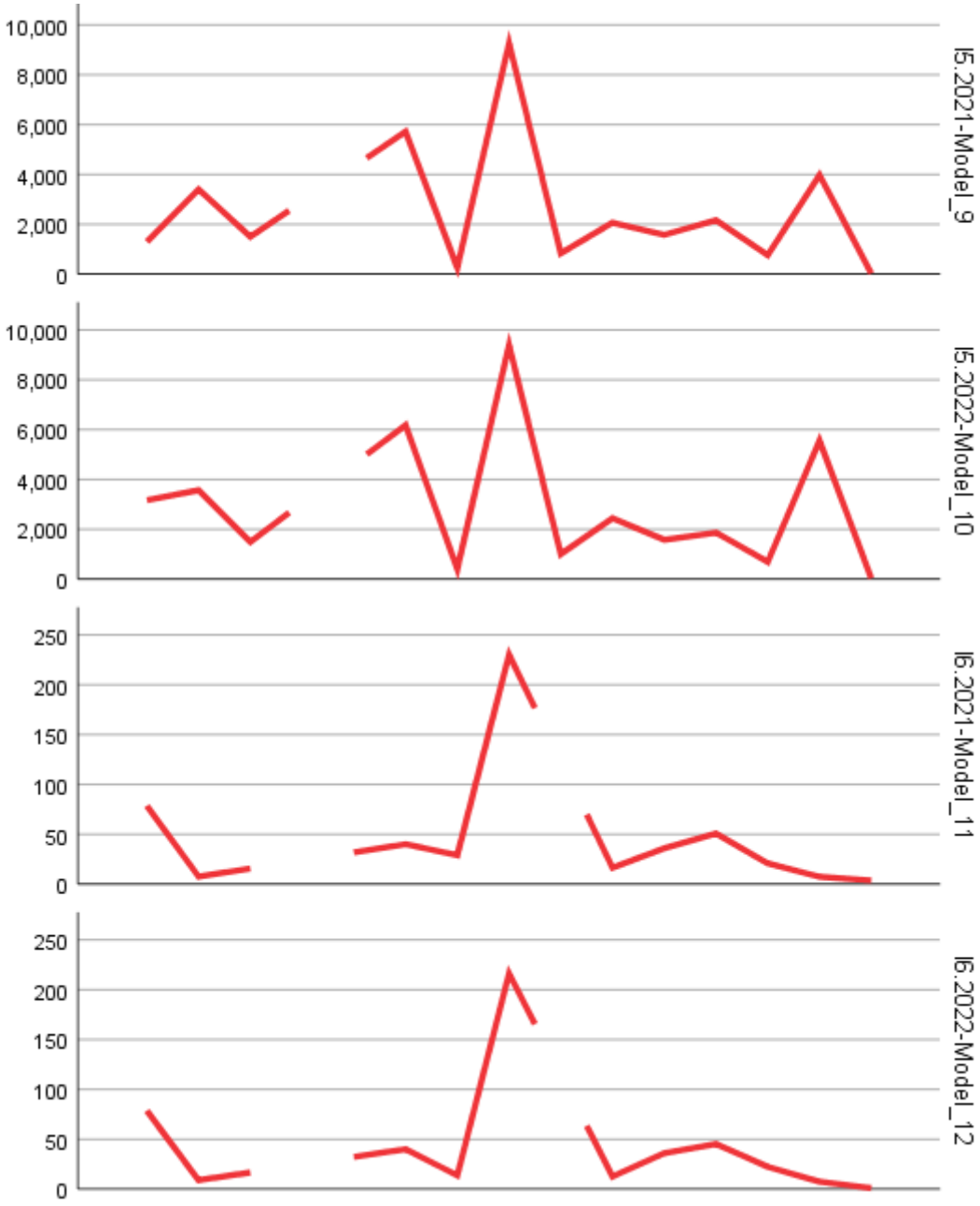

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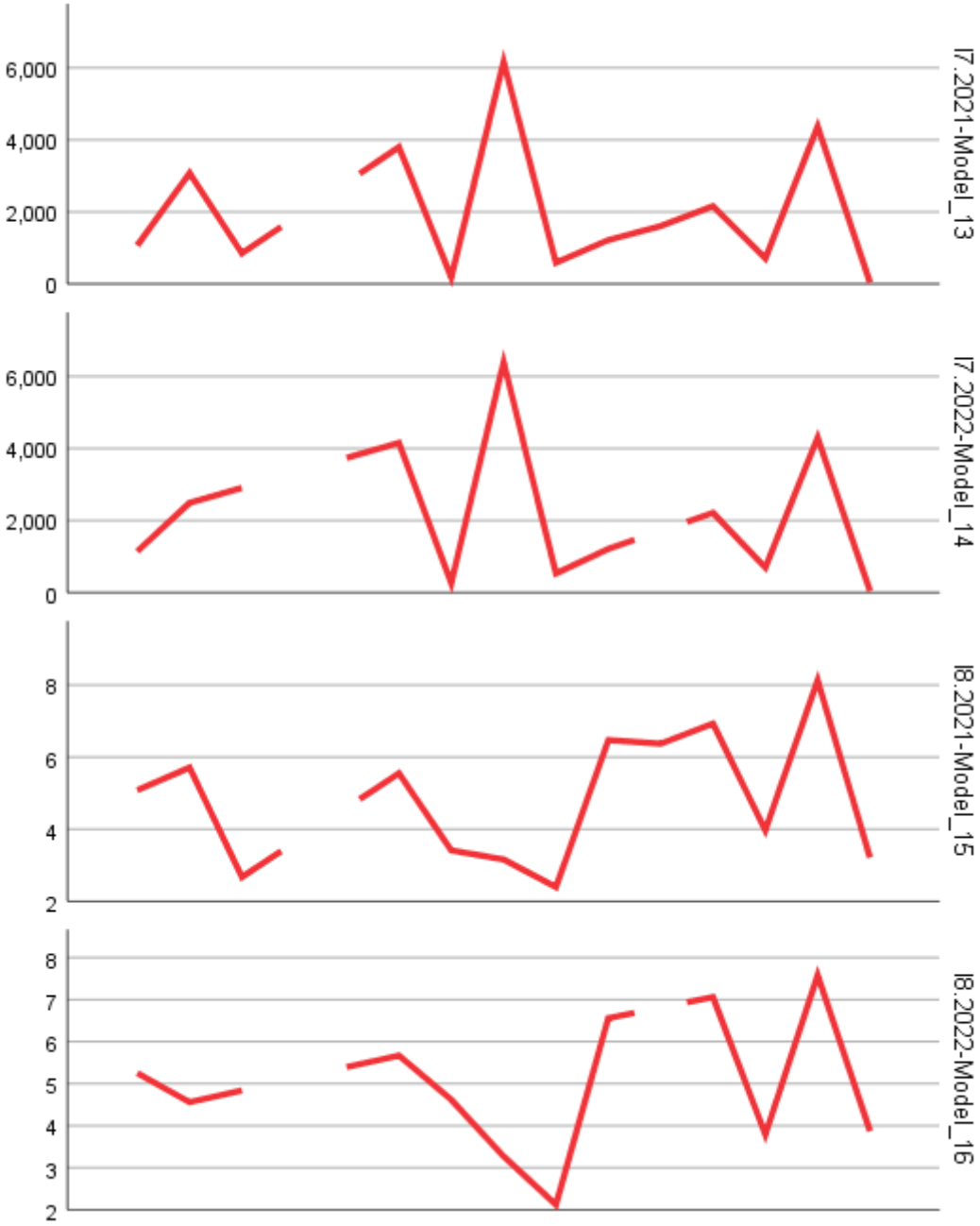

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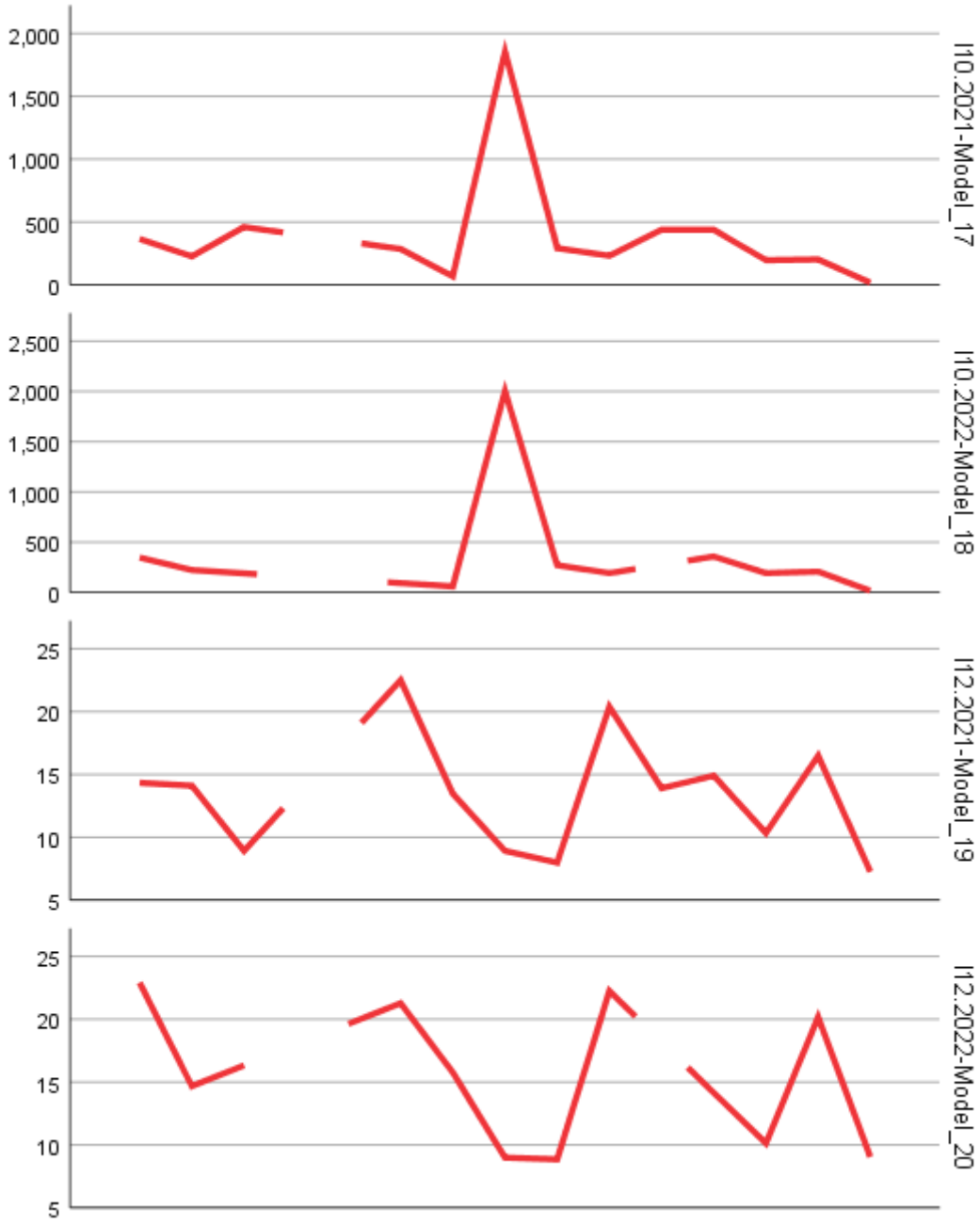

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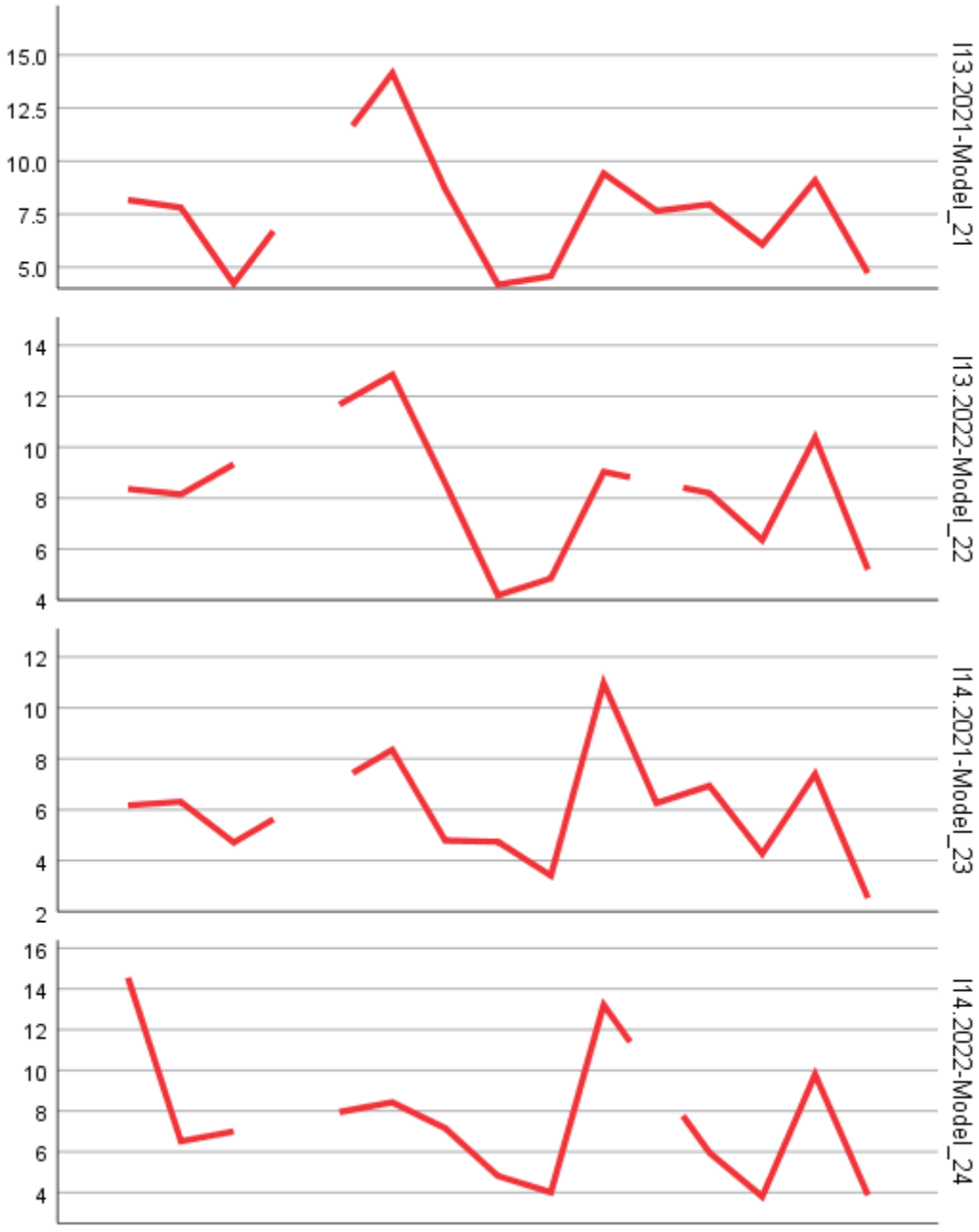

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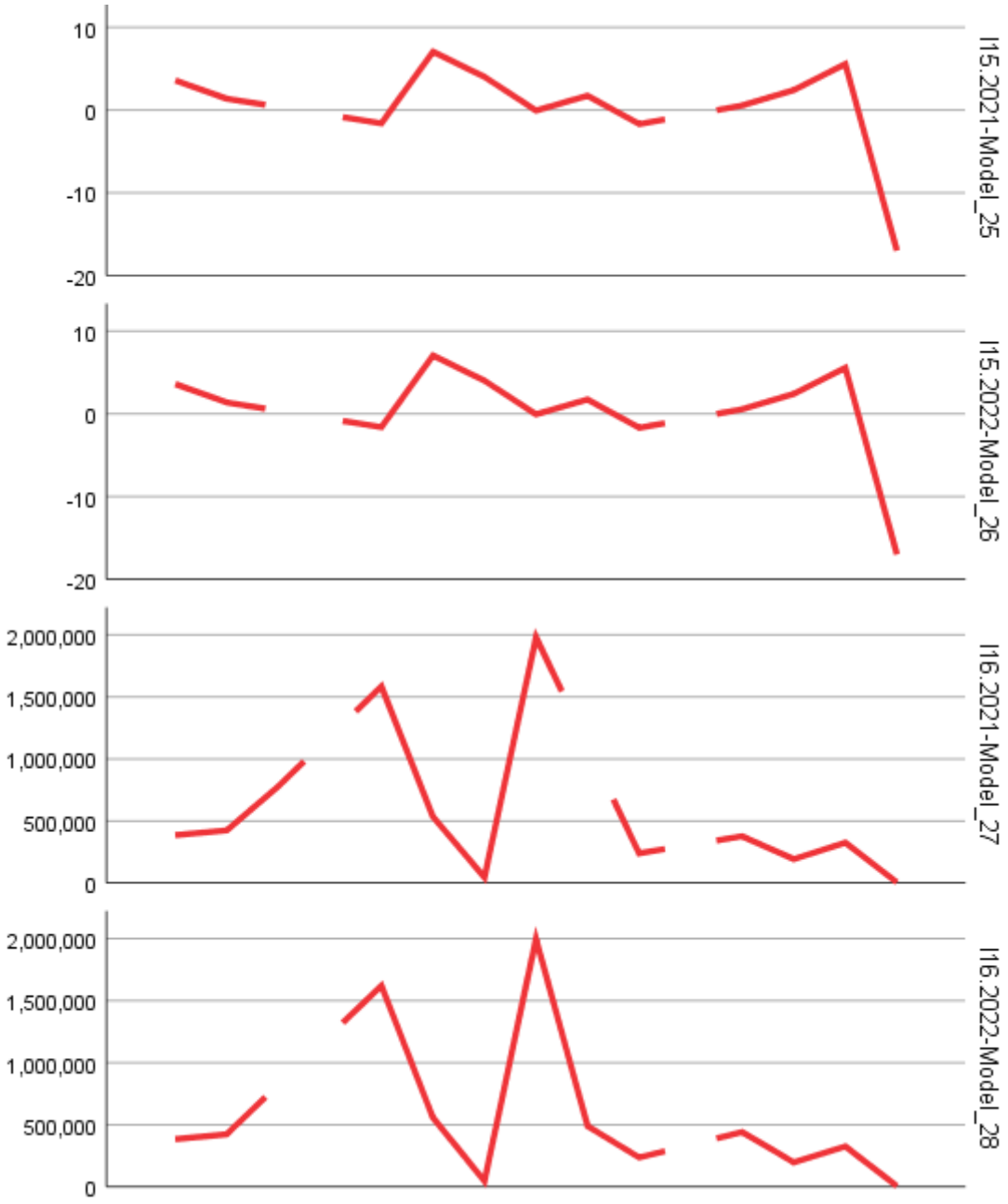

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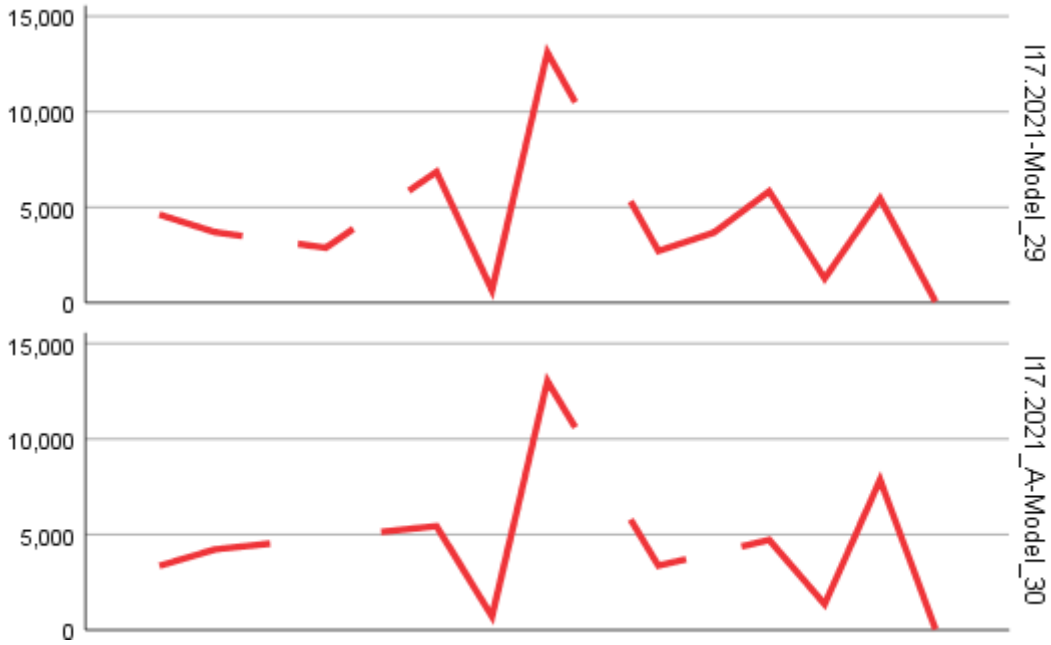

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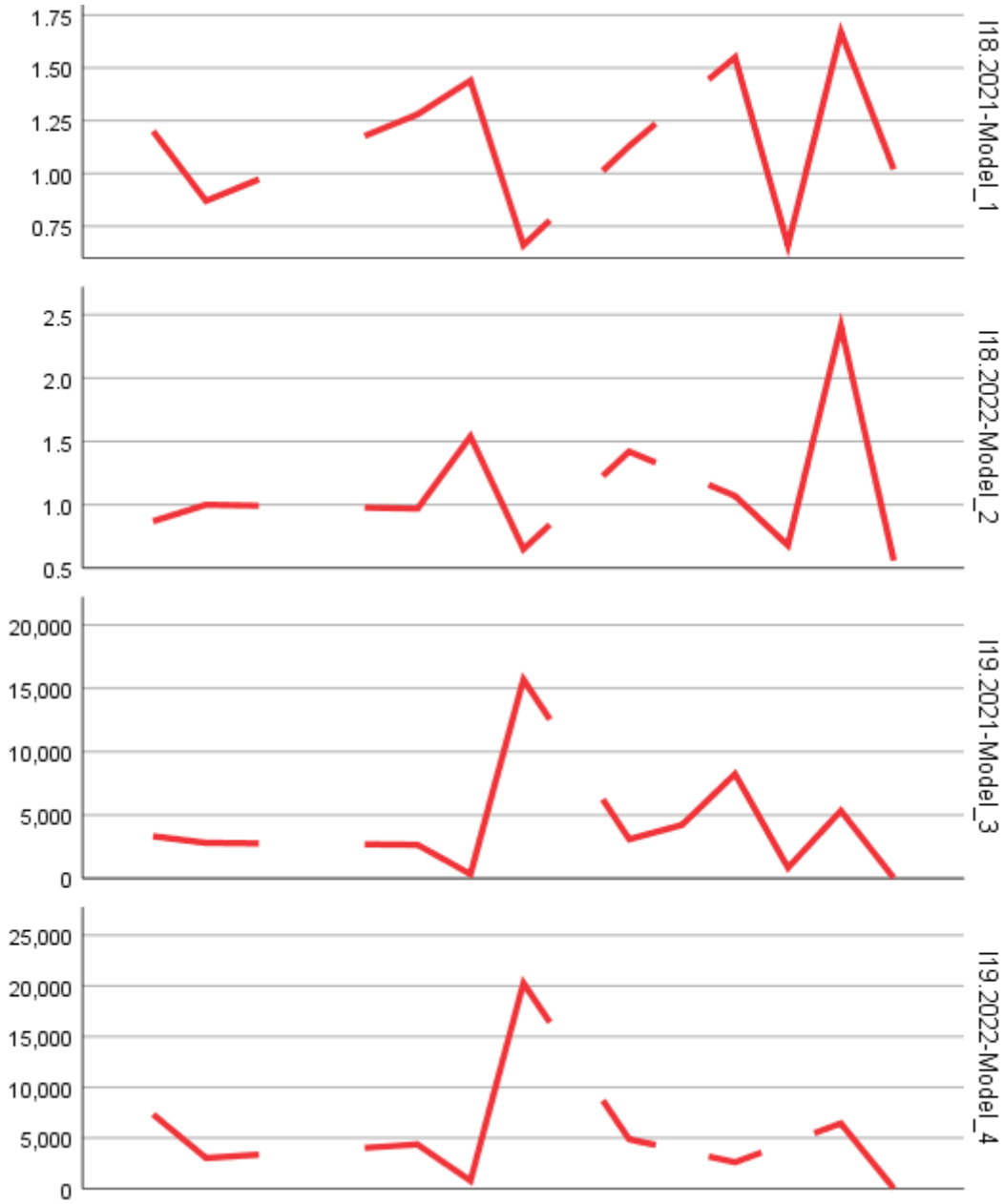

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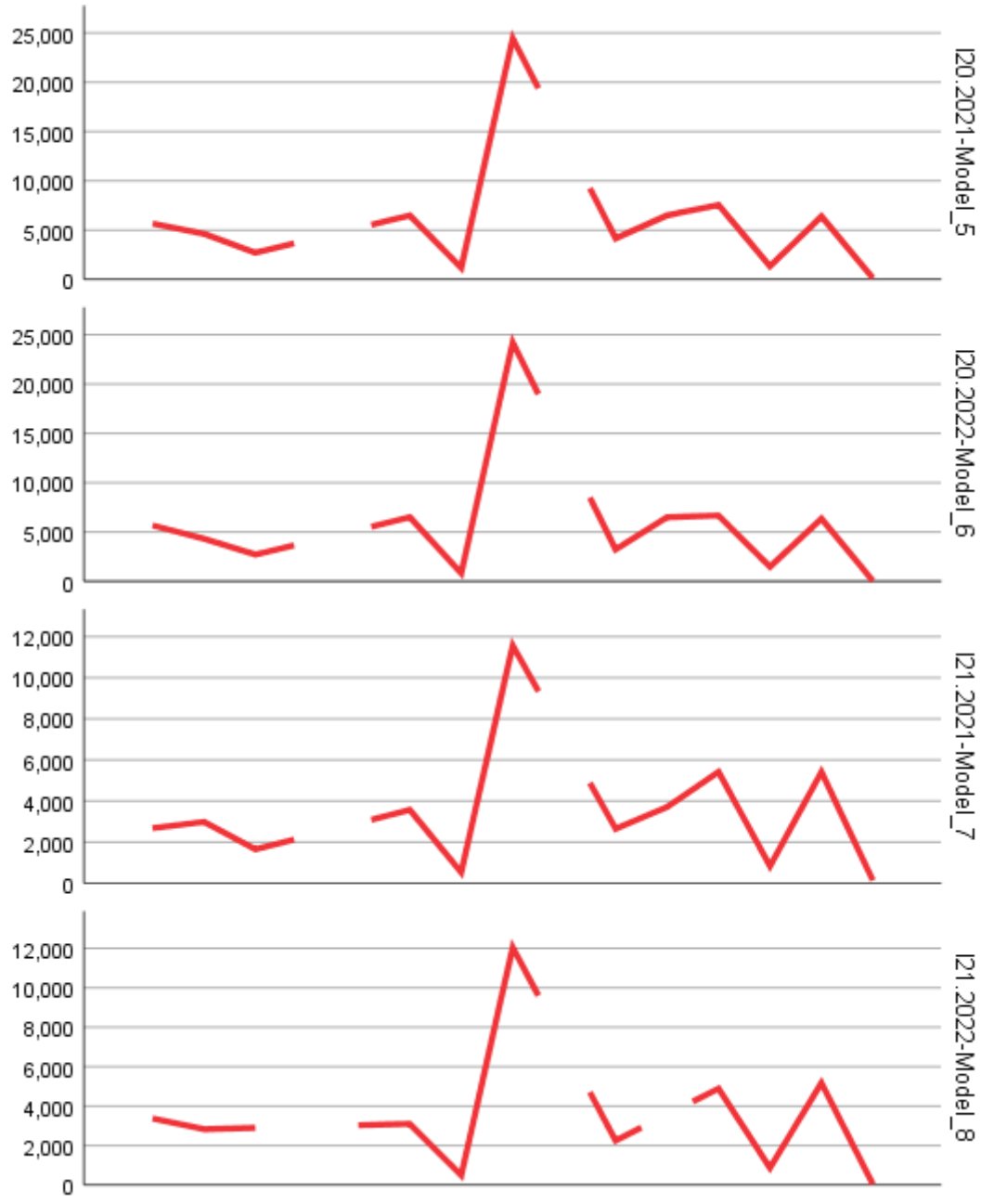

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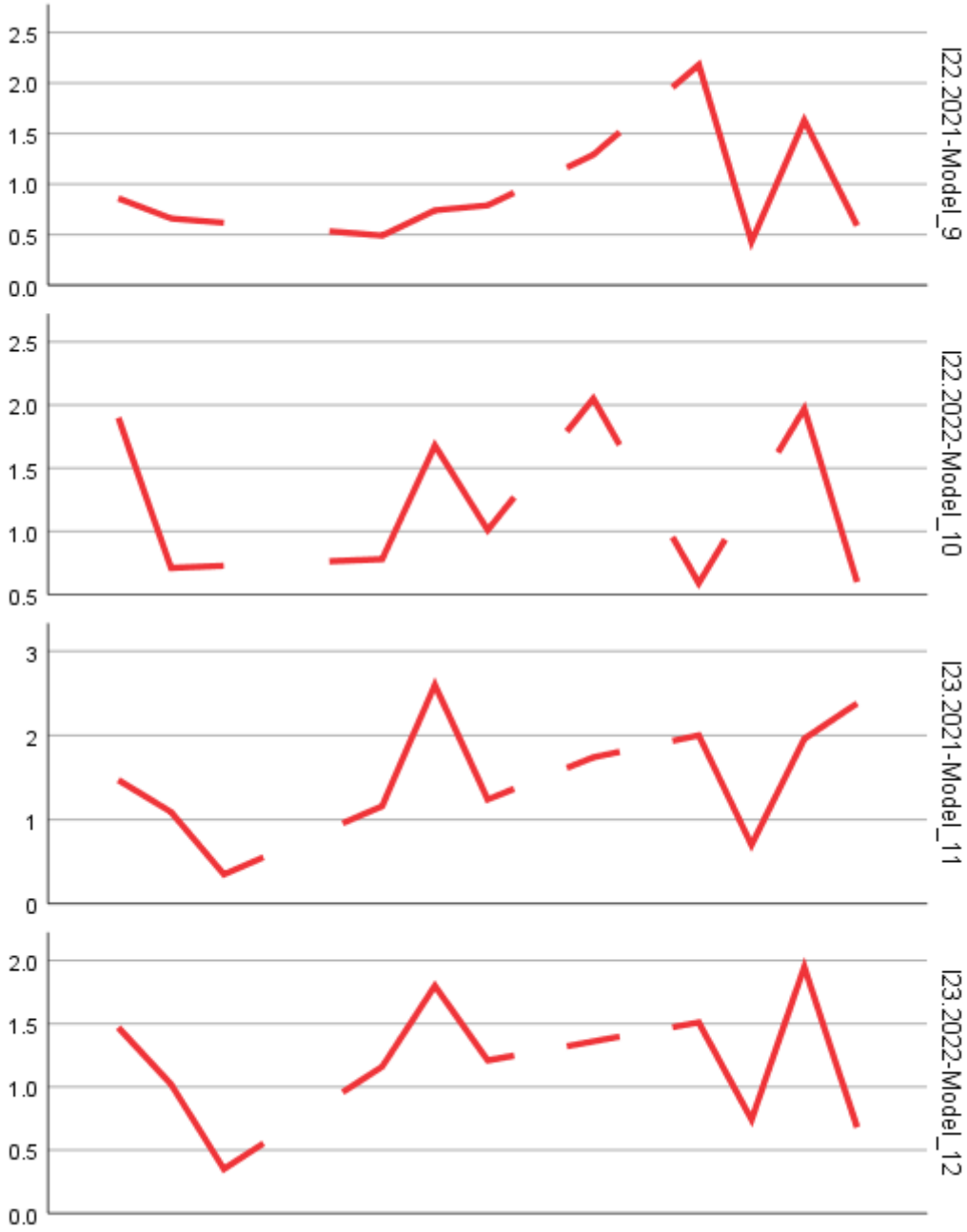

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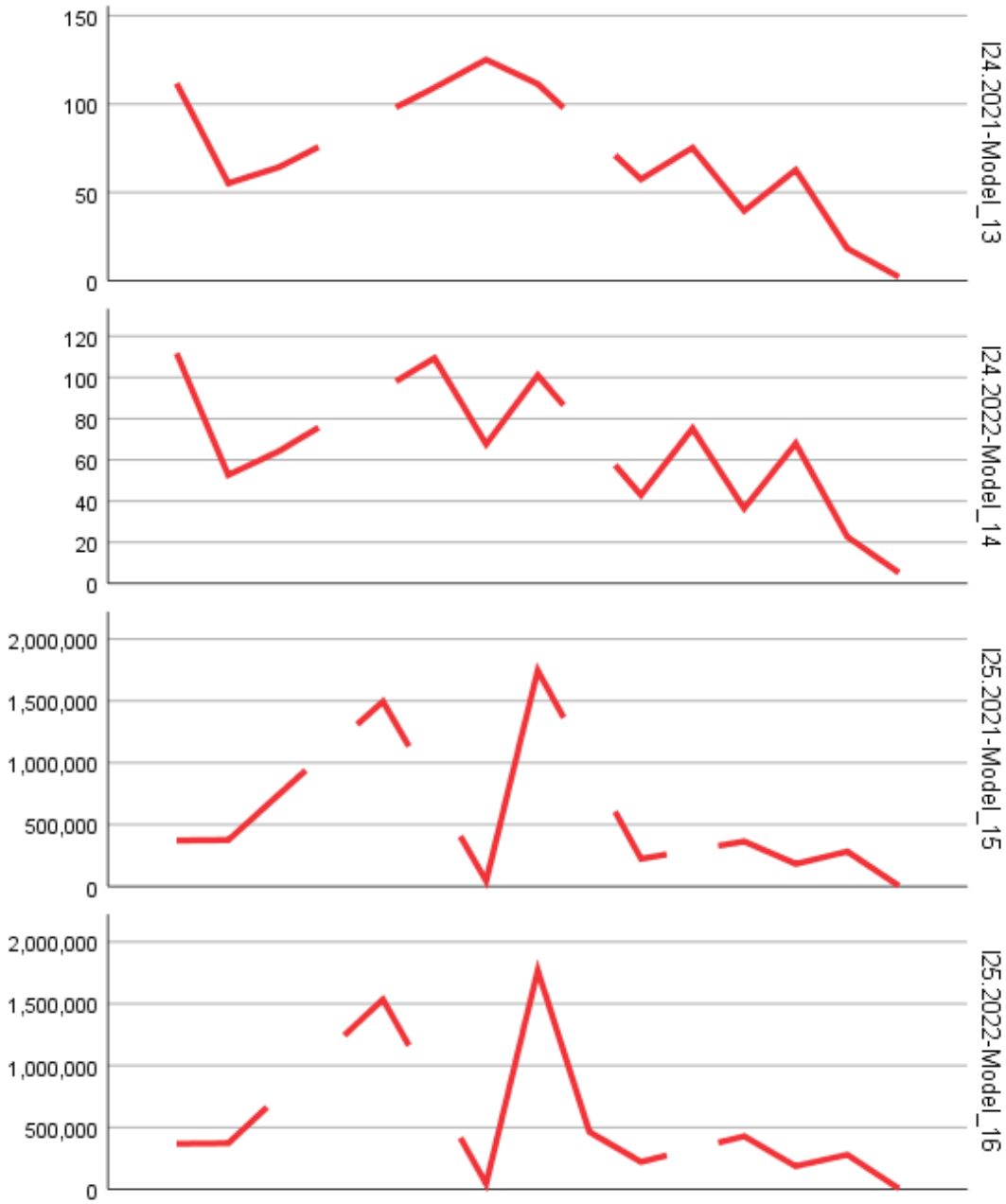

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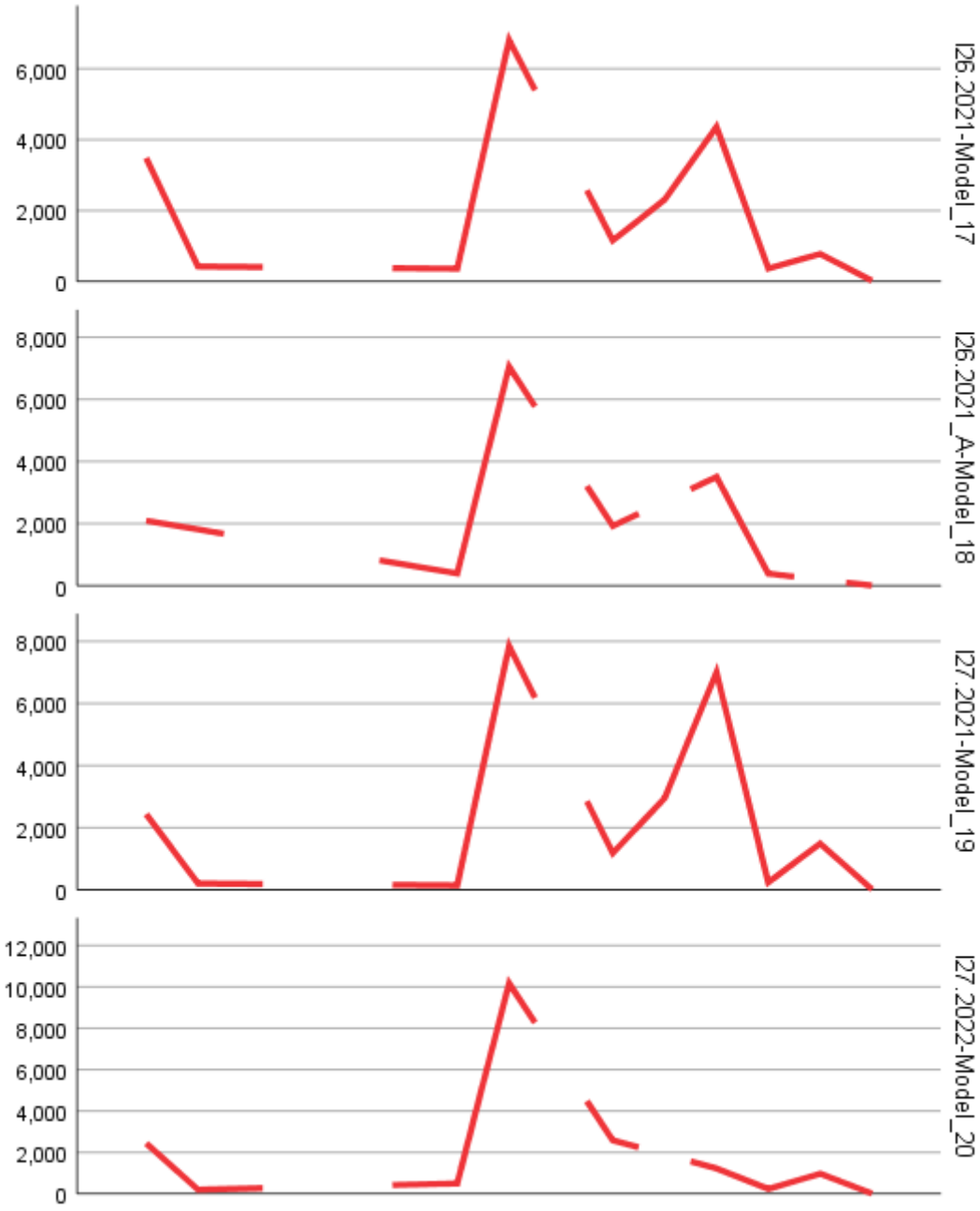

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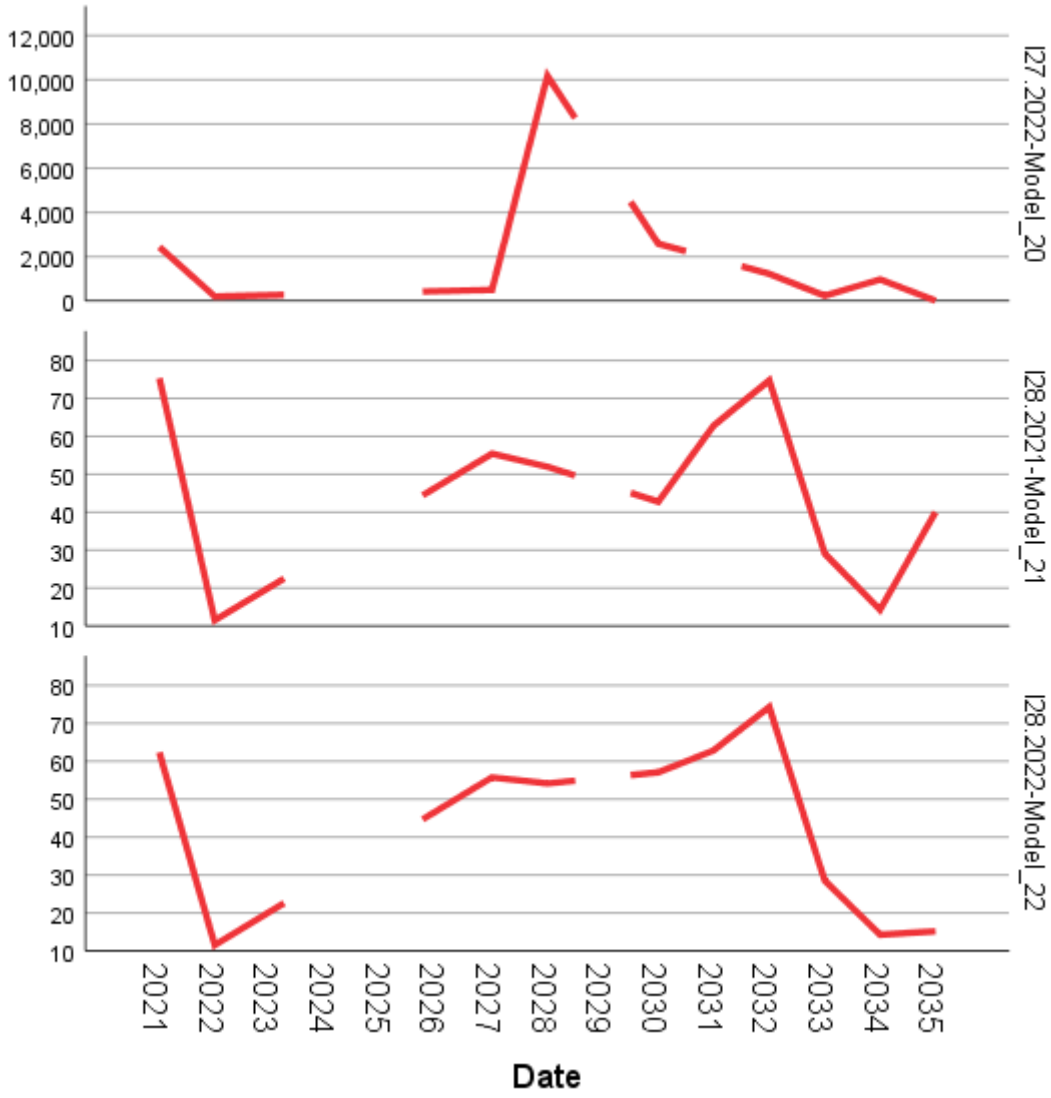

Results

This study presents the dynamics of mountain entrepreneurship in the European industry, using advanced statistical models to assess trends and forecast the development of the industrial sector. The results highlight both the growth potential of this economic niche and the specific challenges faced by businesses in mountain areas.

ARIMA models provide strong forecasts for the evolution of mountain businesses, capturing both seasonality and long-term trends, as shown in the following tables and figures:

- the models with the best accuracy (e.g., I3.2021-Model_5, I3.2022-Model_6) exhibited low errors (RMSE under 0.6, MAPE ~35-40%), indicating good adaptation to the small fluctuations' characteristic of mountain economic activities;

- the models with large variations (e.g., I16.2021-Model_27, RMSE>600000) reflect the volatility of certain segments, especially against the backdrop of external factors (climate change, strong tourist seasonality, or limited access to resources).

Linear regressions confirmed significant correlations between entrepreneurship stimulation policies (subsidies, infrastructure) and the growth of mountain businesses, especially in the fields of tourism, mountain agriculture, and local craftsmanship (as shown in the following tables and figures).

The study of mountain entrepreneurship in the European industry highlights several relevant aspects for the development and sustainability of this sector. Based on the conducted analyses, the

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main characteristics of mountain businesses, success factors, challenges, and emerging opportunities for entrepreneurs in European mountain regions were identified.

European mountain entrepreneurship is characterized by several distinctive features, including:

- dependence on natural resources: most businesses in mountain areas rely on the sustainable use of local resources, including organic farming, mountain tourism, and forestry;
- small business sizes: micro-enterprises and small businesses dominate this sector, many of which are family-owned businesses;
- focus on innovation and sustainability: the use of green technologies and the integration of eco-friendly practices are fundamental aspects of mountain entrepreneurship.

Mountain industrial entrepreneurship plays a crucial role in the economic development of alpine and subalpine regions. Its main features include:

- exploitation and processing of local resources: the mountain industry relies on the extraction of local raw materials such as timber, stone, and rare metals, which are used in various industrial sectors;
- specialized production and traditional crafts: in addition to large production units, mountain areas are recognized for traditional craftsmanship and artisanal industries;
- advanced technologies and sustainability: the development of eco-friendly technologies, such as energy-efficient factories and raw material recycling, contributes to reducing the environmental impact.

From the analysis of the collected data, several essential factors for the success of mountain entrepreneurs emerge:

- access to finance and institutional support: EU funds and rural development programs have a significant impact on the sustainability of mountain businesses;
- collaboration between entrepreneurs and local communities: partnerships and cooperation with local authorities and other businesses contribute to increased competitiveness;
- adaptability to market changes: the ability to innovate and adapt to fluctuating market demands is a key determinant for the longevity of mountain businesses.

Among the main obstacles faced by mountain entrepreneurs, especially in the industrial sector, are as following:

- limited accessibility and deficient infrastructure: transportation and logistics difficulties hinder development and market access;
- dependence on seasonality: most mountain economic activities are strongly influenced by seasonality, leading to fluctuating income;
- challenges in attracting labor: the active population tends to migrate to urban areas, reducing the availability of skilled labor.

Despite the challenges, mountain entrepreneurship benefits from multiple development opportunities:

- growing interest in eco-friendly and sustainable tourism: current trends favor the development of mountain tourism businesses focused on authentic experiences and ecotourism;
- digitalization and online commerce: expanding sales through digital platforms offers new opportunities for accessing international markets;
- renewable energy innovations: the use of renewable energy sources, such as solar and wind power, can help reduce costs and increase sustainability.

These results underscore the importance of supporting mountain entrepreneurship through appropriate policies and support programs to ensure the sustainable economic development of European mountain regions.

European mountain entrepreneurship has significant potential but requires policies tailored to the specific geographical and economic characteristics. The study demonstrates that statistical forecasting tools can guide decisions for:

- supporting mountain SMEs (access to finance, digitalization);
- diversifying economic activities (green energy, agro-tourism);

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- strengthening resilience to crises.

The results serve as a basis for future research and regional policies focused on sustainability. These findings allow for the evaluation of the impact of various economic policies and development strategies on the entrepreneurial sector in mountain regions, highlighting opportunities for growth and sustainable development in this field.

The results suggest that entrepreneurial development strategies in the mountain industry should be adapted to the specifics of each European mountain region. Forecast models and econometric analysis can assist decision-makers in these regions in developing more targeted economic policies that support SME growth, stimulate mountain tourism, and ensure the development of a sustainable mountain economy. Additionally, forecasting models can be used to anticipate economic trends and adjust long-term development strategies in these regions.

Among the most important methods for solving problems in the mountain industry are the development of the food industry and small industries. The food industries and small industries in mountain regions play an essential role in the economy of these areas, having a significant impact on economic development and maintaining the stability of the local population. In the context of European mountain economies, these industries are closely linked to the use of natural resources, such as mountain agricultural products, traditional foods, and local craftsmanship. The food industries, through product diversification and the implementation of eco-friendly technologies, contribute not only to sustaining the local economy but also to creating sustainable jobs. These sectors are often based on traditional production processes, and small businesses, mostly family-owned, play a key role in maintaining the authenticity and distinctiveness of the mountain region.

According to research on mountain economies in Europe, the food industry and small industries have great potential for sustainable development, given the growing demand for eco-friendly and authentic products. At the same time, challenges remain significant, including deficient infrastructure and accessibility issues that limit the expansion of markets for local products. However, there are multiple opportunities for these industries, especially through digitalization and diversification of economic activities such as agro-tourism and rural tourism, which bring additional economic benefits. Investments in infrastructure, institutional support, and the promotion of a favorable legislative framework are essential for increasing the competitiveness and resilience of these industries in the face of economic and climate challenges.

The main conceptual results of the paper can be summarized as follows:

- adapting to the specificity of mountain areas: the results show that uniform strategies are not effective. For example, some regions benefit from investments in tourism, while others need support for traditional industries (wood, dairy products);

- reducing economic gaps: the models identified significant disparities between regions, suggesting the need for differentiated funding programs;

- anticipating risks: data-based forecasts can help manage the impact of climate change and seasonal variations on small businesses.

Conclusion

Mountain industrial entrepreneurship in Europe has significant growth potential but is influenced by both economic and ecological challenges. The forecasting models applied in this study highlighted the main trends and factors that will determine the development of this sector from 2021 to 2035. Initial growth will be supported by sustainable tourism policies and infrastructure investments, while digitalization and economic activity diversification will accelerate development between 2026 and 2030. By 2035, the sector will stabilize, and its development will depend on factors such as automation, adaptation to climate change, and cross-border collaborations. However, regional disparities will persist, with Western European regions holding a significant advantage due to better access to funding and favorable policies.

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To ensure the sustainable development of mountain industrial entrepreneurship, it is essential to invest in infrastructure, promote digital innovations, and support economic policies that assist SMEs and the diversification of economic activities. Collaboration between entrepreneurs and local authorities is another key factor for increasing competitiveness and adaptability in the face of economic and climate changes. Additionally, implementing strategies for the repurposing of abandoned industrial lands in mountain regions could represent an important opportunity for revitalizing these areas and creating new sources of sustainable income.

During the preparation of this manuscript, the authors utilized artificial intelligence tools for assistance in statistical analysis and data interpretation. Following this, the authors rigorously reviewed, validated, and refined all results, ensuring accuracy and coherence. The final content reflects the authors' independent analysis, critical revisions, and scholarly judgment. The authors assume full responsibility for the integrity and originality of the published work.

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