ORIGINAL SCIENTIFIC PAPER
UDK: 658.153:621.39(4)"2009/2020"
005.21:334.726
DOI: 10.5937/EKOPRE2303178S
Date of Receipt: October 31, 2022

Saša Stamenković
Singidunum University
Faculty of Business Economics
Belgrade

Nemanja Stanišić
Singidunum University
Faculty of Business Economics
Belgrade

Tijana Radojević
Singidunum University
Faculty of Business Economics
Belgrade

DETERMINANTS OF EUROPEAN TELECOM OPERATORS' CAPITAL STRUCTURE

Determinante strukture kapitala evropskih telekomunikacionih operatora

Abstract

In recent years, the telecommunications services sector has made a remarkable contribution to the global economy, thereby attracting the interest of researchers. This study aims to examine the relationship between total leverage and its main components (short-term and long-term leverage) and firm-specific and country-specific factors affecting the capital structure of European telecom operators during 2009-2020. The observed period, beginning right after the world economic crisis in 2008, was characterized by a stable economy and the expansion of mobile communications, and the Internet and multimedia services. We used dynamic panel regression models with 9 explanatory and three dependent variables and concluded that liquidity, profitability, sales growth, assets turnover, cost of debt, and non-debt tax shield had a significant influence on the capital structure of European telecom operators. We found that total leverage and long-term leverage significantly depend on their previous year's values. Tangibility, size of firm, and country GDP growth rate were not significantly associated with the capital structure of telecom operators within the observed period. The findings about a dominant negative impact of liquidity and profitability, and the positive impact of sales growth on leverage, are in line with the postulations of the pecking-order theory. This study can be helpful to managers and other stakeholders in improving their understanding of the factors affecting the capital structure of telecom operators.

Keywords: *telecom, capital structure, leverage, dynamic panel regression, GMM, Europe*

Sažetak

Sektor telekomunikacionih usluga je prethodnih godina pružio značajan doprinos svetskoj ekonomiji, čime je privukao pažnju istraživača. Ovo istraživanje ima za cilj da ispita vezu između ukupne zaduženosti i njenih osnovnih komponenti (kratkoročne i dugoročne zaduženosti), i faktora specifičnih za kompaniju i privredu koji su mogli uticati na strukturu kapitala evropskih telekomunikacionih operatora u periodu 2009-2020. Posmatrani period, koji počinje odmah nakon svetske ekonomske krize 2008. godine, karakteriše privredna stabilnost i ekspanzija mobilnih komunikacija, interneta i multimedijalnih usluga. U dinamičkim panel regresionim modelima koristili smo devet objašnjavajuć ih i tri zavisne varijable i zaključili da su likvidnost, profitabilnost, rast prodaje, obrt imovine, cena duga i nedužnički poreski štit imali značajan uticaj na strukturu kapitala evropskih telekomunikacionih operatera. Utvrdili smo da ukupna i dugoročna zaduženost značajno zavise od svojih prošlogodišnjih vrednosti. Struktura imovine, veličina kompanije i stopa rasta BDP-a države nisu značajno uticali na strukturu kapitala telekomunikacionih operatera u posmatranom periodu. Nalazi o dominantnom negativnom uticaju likvidnosti i profitabilnosti, kao i pozitivnom uticaju rasta prodaje na zaduženost, konzistentni su sa predviđanjima teorije hijerarhije (pecking-order). Ova studija može koristiti telekom-menadžerima i ostalima koji su zainteresovani za bolje razumevanje faktora koji mogu da utiču na strukturu kapitala telekomunikacionih operatora.

Ključne reči: *telekom, struktura kapitala, zaduženost, dinamička panel regresija, GMM, Evropa*

Introduction

Telecommunications has been one of the fastest growing and most capital-intensive industries in the past 15 years. At the same time, the telecommunications market has been one of the most competitive markets in the world. It is a consequence of technological development, which included, among other things, the implementation of 4G mobile technology (since 2009), the development and implementation of 5G technology (since 2019), the upgrading of the telecommunications infrastructure, and the construction of fixed optical networks for end users due to the incredible increase in Internet traffic and multimedia services. All these developments required telecommunication service providers to invest heavily in their telecommunication networks and services. The growing number of users proves that telecoms respond to all those business requirements and challenges by investing in networks, employees, and services.

This study investigates how telecoms have financed their investments, which sources have been used to finance their activities, how they managed their capital structure, and what affected their capital structure the most. The main research questions of our study are: (1) Which of the existing capital structure theories is most suitable to explain the European telecom companies' capital structure? (2) How do the selected internal and external factors determine/affect the capital structure of European telecom companies?

Capital structure can be defined as a share of debt in equity or total assets. As an important strategic decision, capital structure policy depends on a firm's performances, business models, and business environment conditions (country and industry characteristics). An optimal balance between the debt and equity means simultaneously minimizing costs and maximizing a firm's value. Despite the optimal capital structure being a moving target, management's constant pursuit of this target is important and desirable. Capital structure is influenced by internal (firm-specific) and external (macroeconomic) factors. Harris and Raviv [24, pp. 333-334] confirmed that capital structure is industry-specific and found that some production sectors, such as drugs, electronics, and food have low leverage, while the industries of steel, cement, paper, and textiles usually have high leverage.

Leverage implies an increase in long-term debt in the capital structure. The positive effect of leverage is reflected in the provisioning of funds for investments and the resulting increase in the firm's profit. The negative effect of leverage stems from an increase in financial risks and an eventual inability to repay the debt. Determining the optimal capital structure means finding a balance between the positive and negative effects of leverage to achieve maximal firm value. Capital structure indicates a firm's health or potential risk of financial distress. It affects a firm's performance, and, therefore, it is important to know which factors affect capital structure and how [21, p. 48].

There is a lack of capital structure research that studies companies from the telecommunications services sector. According to Kumar et al. [29] and their sample of 167 'capital structure determinants' papers from 1972 to 2013, about 50% of studies on capital structure from Europe examine small and medium-sized enterprises (SMEs). The number of studies on large enterprises is also significant. The authors concluded that less than 10% of the papers refer to individual industries, and about three-quarters of the papers deal with groups of different companies from different industries, i.e., a mix of companies from several industrial sectors. As most studies examined companies from single countries, their primary focus was on firm-specific factors rather than macroeconomic factors (e.g. GDP, inflation), which are assumed to have a similar effect on capital structure decisions for all companies. We observed that little research on the capital structure has an international approach and pertains to individual industries, which we identified as a research gap that we try to address with our research.

This study complements the collection of research on capital structure issues. To the best of our knowledge, this research is unique for European telecoms. There are no previous studies about the effects of different factors on telecoms' capital structure. All sampled telecom operators are multi-service operators that provide voice, internet, and multimedia (TV) services, which makes them directly comparable.

Our paper is organized as follows. The next section presents the theoretical background and previous relevant empirical research. The data sources, used variables, and empirical models are described and explained in the third section. The fourth section summarizes the results and discusses our findings, and the last section provides concluding remarks and elaborates on the limitations of the study, as well as suggestions for future research.

Literature review

Capital structure theory

With the assumption of a perfect capital market, without taxes, transaction and bankruptcy costs, conditions of information asymmetry, and the agency problem, Modigliani and Miller [33, p. 258] postulated the theorem that the value of a company is independent of its capital structure. Therefore, their theory is also called the theory of irrelevance, which states that, for the value of a company, it is irrelevant whether the company has debts or not. A company can increase its value even if the capital structure does not change. Realistic business conditions and criticism of their postulates forced Modigliani and Miller [34, p. 434] to include the existence of corporate taxes in their considerations. They corrected their original position – the introduction of taxes means that the value of a company depends on the capital structure. A higher indebtedness ensures the effect of a tax shield (tax reduction) and possibly a higher value for owners (higher profit margin on owner's capital). However, the increase in debt triggers financial risk, and there is often the need for appropriate risk premiums for capital lenders to compensate for the increased probability of the firm's bankruptcy. Modigliani and Miller's theory of irrelevancy was the initiator for further research and the development of theories about capital structure.

Trade-off theory (TOT) – Awareness of the necessity of debt–equity balance led to the initiation of the trade-off theory, which attempts to reconcile the advantages and disadvantages of debt. The convenience of debt is in the interest tax deductions (debt tax shield), and the inconvenience is in the potential costs of bankruptcy. The bottom of the trade-off theory is a balance (compromise) between them and an attempt to find an optimal capital structure. According to this theory, large companies can use their assets as collateral, such as how profitable companies with stable incomes lean towards debt financing. Using leverage is expected to increase returns.

Pecking order theory (POT) – Firm managers almost always have better and more accurate information about the firm's performance and capabilities than the firm's owners or investors. Such an assumption is called information asymmetry and is the basis of pecking order theory (POT). The POT was established by Myers and Majluf [38]. They state that firms prefer financing from internal sources (retained earnings) and try to avoid borrowing. If the company needs more funds, it reaches for external sources of funds – first debt, then corporate bonds, and finally, the issue of shares. Contrary to Modigliani and Miller's theory, the POT considers that the value of the firm depends on the capital structure, regardless of taxes. Since it deals with two types of capital, internal and external, the POT does not recognize the existence of an optimal capital structure, unlike the TOT.

The implications of these two theories have often been discussed and empirically tested in the literature. Although not always unambiguous, the effects of the internal factors affecting capital structure have been suggested in the literature. Starting with Modigliani and Miller [33], apart from the TOT and the POT, several theories about capital structure have been developed, such as market timing theory, agency theory, the theory of signalization, and the theory of free cash flow [28]. All these theories have their arguments in explaining corporate financing, but there is no single and complete answer about optimal capital structure management.

Review of previous research

Among the studies on the determinants of capital structure, we observed several different approaches. First, there was a country-specific approach – for example, Bevan and Danbolt [6] for the UK, Chen [11] for China, Ozkan [39] for Turkey, Mazur [32] for Poland, Handoo and Sharma [23] for India, and Cortez and Susanto [12] for Japan. Second,

there was an industry-specific approach – for example, Pinkova [41] and Afza and Hussain [2] for the automotive industry, Acaravci [1] for manufacturing, Rehman et al. [45] for pharmaceutical, Shambor [47] for oil and gas, and Berkman [5] for energy. Third, there was a multi-country approach – for example, Berkman [5], Delcoure [16], Psillaki and Daskalakis [42], and Moradi and Paulet (2018) for European countries, De Jong et al. [14] and Shambor [47] for a global selection, and Deesomsak et al. [15] for the Asia Pacific. Our study has a multi-country industry-specific approach.

Rajan and Zingales [44, pp. 1453-1454] proved that size, growth, profitability, and tangibility are important factors that affect firms' capital structure in the most developed (G7) countries. They found that the impact of the determinants on capital structure differs among different countries. Mokhova and Zinecker [36, p. 2533] proved that the determinants of capital structure in EU member and EU candidate countries depend on the specifics of the country. Joeveer [26, p. 294] concluded that firm-specific factors are the most influential on leverage for both listed and non-listed large firms in Eastern European countries. Bradley et al. [9, p. 858] noted that firms make sure that their leverage follows the industry average. Titman [50, p. 150] revealed that companies with unique, high-quality offers usually have lower leverage. Bevan and Danbolt [6, p. 159] state that 'analysis of capital structure is incomplete without a detailed examination of all forms of corporate debt', meaning not only leverage but also its components. This approach was applied by many authors, such as Bauer [4], Feidakis and Rovolis [17], and Handoo and Sharma [23], analysing the influence of capital structure determinants on total leverage, short-term leverage, and long-term leverage. Li and Stathis [30, p. 27] and Frank and Goyal [18, pp. 21-22] argued that the significant influence of some determinants on the capital structure of companies is not absolute and unchanging over time; rather, it depends on the business condition and macroeconomic policy.

Berkman et al. [5] performed panel data analysis of 79 European energy companies in the period 2009–2012 and found that liquidity has a negative association with leverage, which supports the POT, while equity turnover and tangibility (asset structure) have a positive association with leverage, which is consistent with the TOT. Investigating the influence of firm-specific and country-specific determinants on capital structure in Russia and the Baltic countries (Estonia, Latvia, and Lithuania) in the period 2002–2008, Tamulyte [48] reveals that tangibility, liquidity, and profitability had a significant impact on total, short-term, and long-term leverage in those four countries. Liquidity had a significant role in all Baltic countries, and profitability was significant in Lithuania and Russia, supporting the POT. Teixeira and Parreira [49, p. 114] noticed that Portuguese commercial ICT companies have higher debt when compared to ICT service providers. Using multiple regression, they found that business risk, size, and tangibility had a significant positive impact on debt and the cost of financing, while the firm's age in years and profitability had a significant negative impact on debt. Shambor [47] analysed 346 global oil and gas firms from six continents in the period 2000–2015. By using six explanatory variables (growth, tangibility, profitability, size, liquidity, and non-debt tax shield), he found that the capital structure policy of global oil and gas companies is mainly consistent with POT, due to the dominant negative influence of profitability, tangibility, and liquidity.

Li and Stathis [30, p. 29] determined that, although Australian companies mainly follow the POT, in times of higher taxes, they redirected towards the TOT. Frank and Goyal [18, p. 1] proved that US companies lean toward the TOT. Guner [22, p. 84] examined the capital structure determinants for listed non-financial Turkish firms in the period 2008–2014 and found that most of the analysed determinants are in line with POT. Mateev et al. [31, p. 28] also found more support for POT. They conducted a panel data analysis of 3,175 SMEs from seven Central and Eastern European (CEE) countries during the period 2001–2005 and found that medium-sized firms prefer internal financing over external ones, unlike small firms. Hernadi and Ormos [25] analysed capital structure in two ways: qualitative and quantitative. They applied panel regression for 498 firms from 10 CEE countries in the period 2005–2008 and conducted a qualitative survey among CFOs

of those firms about the firms' financial policies. The results of the panel regression are in agreement with the responses of the CFOs that POT is the dominant relevant theory in explaining the financial decisions of CEE firms. About three-quarters of the observed CEE firms were not at their targeted levels of financial leverage, preferring a higher use of internal funds.

Studies dealing with the capital structure of telecom operators in the previous period were rare. Using the empirical method of a case study of three leading European operators (BT Group, Deutsche Telekom, and France Telecom) in the period 1994–2003, Carapeto and Shah [10, p. 200] concluded that the optimal value of the capital structure (debt/equity) of telecom operators exists and that its value is about 60%. The authors also pointed out that the majority of state-owned companies often exceed their debt capacity, because the state practically protects them from bankruptcy. In the example of five telecom operators that operated in Indonesia in 2008–2015, Rahmatillah and Prasetyo [43] found that size, tangibility, liquidity, risk, interest rate, GDP, and ownership are factors that significantly affect the capital structure of Indonesian telecom operators, while profitability and effective tax rate had no significant effect.

Even with several theories being offered and numerous empirical studies being conducted on the topic of capital structure determinants, the topic is still actively researched and discussed in the literature.

Research methodology

Variables in the model

Various authors have used different sets of potential determinants of capital structure, depending on the possibility of finding appropriate data to calculate and define these determinants. Titman and Wessels [51] and Harris and Raviv [24] were among the first to investigate potential determinants of capital structure. In the common group of determinants, they identified profitability, size, asset structure, non-debt tax shield, growth, earnings volatility, uniqueness, and industry classification. Pandey and Singh [40, pp. 171-172] enumerated 13 determinants of capital structure most often used in research from 2002 to 2015. In this paper, we selected seven of them: size, growth opportunity, assets tangibility, profitability, non-debt tax shield, liquidity, and cost of debt.

The variables were chosen to acknowledge the diversity of the analysed telecom operators in terms of size, corporate efficiency, and the market in which they operate. All of these variables have been used in previous literature, as can be seen in Table 1.

The following paragraphs explain the nine predictor variables used in our econometric model.

Growth Opportunity (GROS) – Fast-growing companies generally do not have enough of their own funds to invest in new projects, and they have to take on debt. So, POT

Table 1: Description, measure, and reference of used variables

Variables	Abbr.	Measure	References
Dependent variables			
Leverage	LEV	Total Liabilities / Total Assets	Bauer [4]; Psillaki and Daskalakis [42]; Viviani [52]; Guner [22];
Short-term Leverage	STLEV	Short-term Liabilities / Total Assets	Pinkova [41]; Feidakis and Rovolis [17]; Handoo and Sharma [23];
Long-term Leverage	LTLEV	Long-term Liabilities / Total Assets	Pinkova [41]; Feidakis and Rovolis [17]; Handoo and Sharma [23];
Independent variables			
Growth	GROS	(Sales(t) – Sales(t-1)) / Sales(t-1)	Karadeniz et al. [27]; Alipour et al. [3];
Liquidity	LIQ	Current Assets / Current Liabilities	Bradley et al. [9]; Ozkan [39]; Mazur [32]; Berkman et al. [5];
Profitability	PROF	ROA = EBIT / Total Assets	Rajan and Zingales [44]; Bauer [4]: Mazur [32]; Karadeniz et al. [27];
Size of firm	SIZE	Natural Logarithm of Sales	Titman and Wessels [51]; Delcoure [16]; Afza and Hussain [2]; Tamulyte [48];
Tangibility	TANG	Fixed Assets / Total Assets	Booth et al. [8]; Frank and Goyal [18]; Cortez and Susanto [12]; Moradi and Paulet [37];
Assets Turnover	ASTUR	Sales / Total Assets	Feidakis, Rovolis [17]; Serghiescu and Vaidean [46]; Berkman et al. [5];
Non-Debt Tax Shield	NDTS	Depreciation & Amort. / Total Assets	Bradley et al. [9]; Ozkan [39]; Cortez and Susanto [12]; Moradi and Paulet [37];
Cost Of Debt	COD	Interest Paid / Long-term Liabilities	Afza and Hussain [2]; Teixeira and Parreira [49]; Handoo and Sharma [23];
GDP Growth	GDPG	Annual country GDP growth (%)	Booth et al. [8]; Feidakis and Rovolis [17]; Gaud et al. [19];

Source: Authors' layout based on previous studies

assumes a positive relationship between growth and leverage. In contrast, TOT expects a negative relationship because it believes that high leverage threatens the firm's growth, as well as its sustainability.

Liquidity (LIQ) – TOT advocates the positive impact of liquidity on leverage. TOT believes that good liquidity guarantees interest payments and debt use. In contrast, POT expects a negative relationship between liquidity and leverage because a cash-rich firm has real possibilities to service its investments without borrowing.

Profitability (PROF) – TOT implies a positive relation between profitability and leverage. This theory holds that more profitable companies can get loans more easily. Also, such companies want to use debt to reduce their tax liabilities (using the tax shield), thereby increasing profitability. In contrast, POT sees a negative relation between profitability and leverage, suggesting that more profitable companies have more retained earnings that they can use for new investments. It is also a benefit that internal financing is cheaper than external financing.

Firm Size (SIZE) – Larger companies regularly report on their operations, have more assets, and have a lower probability of financial distress due to a more diversified business. Such companies have relatively easy access to the financial market and can take more debt at lower prices. Therefore, according to TOT, firm size is positively associated with leverage. POT considers that larger companies have more internal funds that they will use before reaching for external ones. Therefore, POT predicts a negative relationship between firm size and leverage.

Tangibility (TANG) – We use tangible assets to measure the asset structure of telecom operators. TOT expects that asset tangibility is positively related to leverage. More tangible assets imply more collateral for creditors, which leads to decreased credit risk and risk of bankruptcy. According to POT, higher tangibility means lower leverage – a negative relationship.

Assets Turnover (ASTUR) – This is a proxy to measure the efficiency of using the assets and shows how many units of sales revenue were generated by a unit of the total assets. There is no clear empirical result on the impact of this proxy on leverage because this variable has only been analysed in a few prior studies. This research will contribute to the literature by providing insight on this effect.

Non-debt Tax Shield (NDTS) – The non-debt tax shield includes all expenses that affect tax reduction, except for interest expenses. Depreciation and amortisation (D&A) usually have the largest share in NDTS. D&A are non-cash expenses; they do not cause cash outflow and they reduce the need for loans. Therefore, NDTS reduces tax payments, indirectly increasing the firm's internal funds and reducing the need for debt – consistent with the POT. Based on TOT, higher NDTS leads to a decrease in the firm's tangible assets, which can be collateral for easier borrowing. This means that NDTS is negatively related to leverage in both the TOT and the POT.

Cost of Debt (COD) – COD is an effective interest paid on a firm's outstanding long-term debts. In the capital structure theories, there is no precise expectation about the influence of COD on leverage. The high cost of debt certainly discourages the use of leverage, although interest costs are tax-deductible.

Country GDP Annual Growth (GDPG) – A favourable economic situation and economic development have a positive impact on a company's performance – demand grows, sales grow, profit grows. Therefore, in such circumstances, a company can be financed either from increased internal funds or by taking on debt under appropriate conditions. There is no clear theoretical postulation on the impact of GDPG on leverage.

Different calculations of explanatory variables limit the potential for generalizing the findings. When comparing results from various authors, one should take into consideration the apparent diversity of variable calculation methods.

Data source

The sample is based on a hand-collected data set comprised of annual reports or financial statements published on the official corporate websites of 46 European telecom operators from 32 countries. The study covers a period of 12 years, from 2009 to 2020. The data form a strongly balanced panel data model. Our sample was selected according to the availability of complete financial data in the observed

period. We relied on the values reported in annual/financial reports (i.e., book values). The sampled telecom operators include both listed and non-listed, predominantly state-owned and privately owned, national and multinational, ex-incumbent and alternative operators, but all operators are so-called multiservice operators (MSOs).

Some data needed to calculate the required ratios (e.g. GROS) were collected from the financial reports for 2008. Given that financial data in annual reports are mainly expressed in national currencies, to calculate some variables in the model (e.g. SIZE), we had to normalize the data values and express them in euros, according to the exchange rate of the national currency on December 31 for each observed year. The exchange rate values of 20 different currencies had to be converted into euros. Data on the annual GDP growth rate of European countries were downloaded from the official website of the World Bank (https://data.worldbank.org/indicator/ NY.GDP.MKTP.KD.ZG).

The Stata 17 program was used for data processing.

Regression model

Following the recommendation of leverage decomposition [6, p. 159], we consider three regression models with the three dependent variables LEV, STLEV, and LTLEV, as defined in Table 1. These three dependent variables were also used by Bauer [4], Feidakis and Rovolis [17], Pinkova [41], Afza and Hussain [2], and Handoo and Sharma [23], among others. Panel data analysis takes into account both differences between firms and time effects. Following Ozkan [39], Gaud et al. [19], Karadeniz et al. [27], Mateev et al. [31], and Vo [53], among others, we chose a dynamic panel data analysis over a static one because it more effectively solves the problems of heteroscedasticity and autocorrelation, as well as possible data endogeneity. Getzmann and Lang [20, p.13] highlighted that 'endogeneity often exists in econometric models'.

At the same time, in our empirical model, we check how the leverage from the previous year affects the current leverage, following Ozkan [39]. Gaud et al. [19, p. 52] promoted the attitude that 'capital structure decisions are dynamic by nature'. Given that a firm's decisions on capital structure often fluctuate and that there is a possibility of endogeneity problems among the independent variables, we decided to apply the generalized method of moments (GMM). GMM regressions are robust to heteroscedasticity and autocorrelation [20, p.15]. Alongside the independent variables, the lagged value of the dependent variable appears in the model as an additional variable to examine its influence.

Our general empirical regression model is expressed in the equation form (1) as follows:

$$Yit = \beta_0 + \beta_1 Y_{i,t-1} + \Sigma_{k=2}^{10} \beta_k X_{kit} + \mu_i + \varepsilon_{it} \qquad (1)$$

where the case Y=LEV represents regression model 1, Y=STLEV represents regression model 2, and Y=LTLEV represents regression model 3; Yt-1 is the lagged dependent variable; the subscript *i* represents cross-sectional dimension (firms, telecoms) and *t* represents time-series dimension (years), whereby *i*=1 to 46, *t*=1 to 12; β0 – β10 regression coefficients, μ – unobserved individual effects, ε – error term, and X2 to X10 (k=2 to 10) are variables GROS, LIQ, PROF, SIZE, TANG, ASTUR, NDTS, COD, and GDPG, as defined in Table 1, respectively.

The Stata 17 program was used for data processing.

Results and discussion

The data are analysed by descriptive statistics, correlation analysis, and dynamic panel data regression.

Descriptive statistics

Table 2 provides the descriptive statistics – a summary of the mean, median, standard deviation, minimum, and maximum values of the selected variables.

Leverage has a mean value of 54.59% and a median of 56.64%. That represents a good balance in debt/equity financing. Telecoms, on average, are not overburdened with debt, despite the need for continuous investments. On average, among telecoms, STLEV has lower participation in total leverage than LTLEV, with LTLEV making up around 60% of LEV. The profitability, measured as ROA, has a mean value of 8.97% and a median of 8.05%, which confirms that providing telecom services is a profitable

activity. The mean value of annual sales growth is 1.6%, which is comparable to the mean of countries' GDP growth (1.1%). The average liquidity (current ratio) is 1.11, which is considered a good value for non-manufacturing companies. The average tangibility is 40%, although there have been significant investments in telecom networks and equipment in previous years. However, in today's era of digitalization of business and virtualization of network functions and services, telecoms are investing more and more in their intangible assets (e.g. enterprise business and operation-support software, user licenses, TV rights).

Correlation analysis

The correlation analysis presents the relationship between each pair of variables used in our empirical model. A Pearson's correlation matrix is reported in Table 3. The results of the correlation analysis indicate a significant moderate positive correlation (0.4–0.6) between leverage and liquidity and leverage and tangibility, as well as a significant moderate negative correlation between leverage and the size of firms. PROF, NDTS, and GDPG have a negative correlation with leverage, while GROS has a positive correlation with leverage. Among the independent variables, a significant moderate positive correlation (0.4–0.6) exists between SIZE and LIQ, SIZE and TANG, NDTS and TANG, ASTUR and PROF, and ASTUR and NDTS.

To check the presence of multicollinearity among the independent variables, we performed a variation inflation factor (VIF) test. A VIF value greater than 10 is considered an indication of a multicollinearity problem. The results of the multicollinearity VIF test are specified in the final column of Table 3. VIF values (<10) show that there is no problem with multicollinearity between the selected variables, and there is no need to omit any of them from our econometric model. However, some values of correlations (0.4–0.6) between the previously described independent variables raise doubts about the endogeneity of the data, which justifies the application of the GMM method.

Regression analysis

After the multicollinearity test, we checked the data for the presence of autocorrelation and heteroscedasticity. The results of the White test for heteroscedasticity proved

Table 2: Descriptive statistics

	LEV	STLEV	LTLEV	GROS	LIQ	PROF	SIZE	TANG	ASTUR	NDTS	COD	GDPG
Mean	0.5459	0.2184	0.3275	0.0156	1.1080	0.0897	7.7461	0.4000	0.5326	0.0992	0.0663	0.0108
Median	0.5664	0.2146	0.3203	-0.0001	0.8315	0.0805	7.8979	0.3953	0.5020	0.0986	0.0437	0.0183
Std. Dev.	0.2357	0.0826	0.2138	0.1320	0.7911	0.0763	1.6653	0.1392	0.1912	0.0298	0.1252	0.0371
Min.	0.0759	0.0504	0.0053	-0.5578	0.1358	-0.0292	4.2920	0.0990	0.0997	0.0374	0.0001	-0.1531
Max.	1.4322	0.6225	1.2066	1.3162	4.5212	0.4919	11.5229	0.8490	1.3917	0.3002	1.5797	0.1120
Obs.	552	552	552	552	552	552	552	552	552	552	552	552

Source: Authors' calculations in Stata 17

Table 3: Correlation matrix and multicollinearity VIF test

	LEV	STL	LTL	GROS	LIQ	PROF	SIZE	TANG	ASTUR	NDTS	COD	GDPG	VIF
LEV	1.000												
STL	0.428	1.000											
LTL	0.937	0.086	1.000										
GROS	0.079	0.016	0.081	1.000									**1.04**
LIQ	-0.597	-0.556	-0.443	-0.064	1.000								**1.27**
PROF	-0.134	0.110	-0.190	0.072	0.152	1.000							**1.68**
SIZE	0.549	0.256	0.506	0.032	-0.401	-0.061	1.000						**1.44**
TANG	-0.425	-0.064	-0.443	0.010	0.202	0.170	-0.428	1.000					**1.64**
ASTUR	-0.047	0.482	-0.238	0.039	-0.019	0.578	-0.046	0.364	1.000				**2.51**
NDTS	-0.008	0.198	-0.086	-0.020	0.006	0.199	-0.165	0.461	0.580	1.000			**1.87**
COD	-0.117	0.171	-0.196	-0.015	-0.035	0.003	-0.113	0.206	0.143	-0.011	1.000		**1.22**
GDPG	-0.050	-0.014	-0.050	0.147	0.033	0.010	-0.069	0.042	0.038	0.008	-0.248	1.000	**1.12**

Source: Authors' calculations in Stata 17

the presence of heteroscedasticity (chi2(54)=94.53, p=0.0005<0.05; the null hypothesis of homoscedasticity is rejected). A Wooldridge test for autocorrelation in panel data indicated an autocorrelation problem (F(1,45)=5.733, p=0.0209<0.05; the null hypothesis of no first-order autocorrelation is rejected).

After these tests, we applied the GMM proposed by Blundell and Bond [7] to control for potential endogeneity among the independent variables and to address the existing heteroscedasticity and autocorrelation problems. We performed a two-step robust system GMM estimation using the Stata command *xtdpdgmm*. The results of the dynamic GMM panel data analysis are presented in Table 4.

The quality of the applied GMM estimator is evaluated based on the overall validity of the selected instruments. That validity is determined using the Sargan–Hansen test of over-identifying restrictions and the Arellano–Bond second-order autocorrelation test (AR(2)). In our model, the AR(2) test confirms the absence of serial correlation between the instruments and the error term (p>0.05). The Sargan–Hansen test shows that the null hypothesis cannot be rejected (H0=over-identifying restriction is valid, p>0.05). The results of these two tests confirm that the instruments are valid, which means that our model is specified correctly.

The results in Table 4 show that the significant determinants of total leverage are lagged leverage, annual growth of sales, profitability, liquidity, assets turnover, and non-debt tax shield. The significant determinants of short-term leverage are annual growth of sales, liquidity, assets turnover, non-debt tax shield and cost of debt. The significant determinants of long-term leverage are lagged long-term leverage, annual growth of sales, profitability, liquidity, and cost of debt.

The current total leverage and long-term leverage of European telecoms strongly depend on the past (lagged leverage and lagged long-term leverage), as Ozkan [39, p. 187] also claims. Long-term indebtedness is a long-term characteristic of telecoms, so the LTLEV lag is very strong (coefficient=0.95). In contrast, the current short-term leverage does not significantly depend on the past. This is understandable, as short-term leverage depends on the level of current liabilities related to operational business.

Profitability has a significant negative relationship with LEV at a level of 1% significance and with LTLEV at a level of 10% significance. This means that telecom operators keep part of their profit and use it for investments before reaching for debt, which supports the assumptions of POT. However, profit increases capital, reducing the need for external sources of financing. These findings are consistent with Rajan and Zingales [44], Bauer [4],

Table 4: The results of the GMM regression analysis

Depend. var.	LEV			STLEV			LTLEV		
	GMM robust system			GMM robust system			GMM robust system		
Independ. var.	Coefficient	z	P>|z|	Coefficient	z	P>|z|	Coefficient	z	P>|z|
L1. LEV	0.95134***	12.39	**0.000**						
L1. STLEV				0.20027	1.63	0.103			
L1. LTLEV							0.94936***	7.29	**0.000**
GROS	0.08158**	2.34	**0.019**	-0.03261*	-1.70	**0.090**	0.10769***	3.07	**0.002**
LIQ	-0.02459***	-3.32	**0.001**	-0.05055***	-5.59	**0.000**	0.01131*	1.67	**0.095**
PROF	-0.25720***	-4.16	**0.000**	-0.12750	-1.51	0.130	-0.17286*	-1.74	**0.081**
SIZE	0.02257	1.15	0.249	0.00947	0.67	0.504	0.01395	0.82	0.410
TANG	-0.02004	-0.22	0.829	-0.07510	-1.27	0.206	-0.09800	-1.51	0.130
ASTUR	0.13618***	2.98	**0.003**	0.10169***	2.64	**0.008**	0.07749	1.35	0.178
NDTS	-0.81735**	-2.19	**0.028**	-0.35863**	-2.09	**0.036**	0.13612	0.86	0.392
COD	-0.10792	-1.60	0.110	0.12656*	1.66	**0.097**	-0.13944***	-3.55	**0.000**
GDPG	0.06646	0.65	0.515	0.06527	0.95	0.344	0.02985	0.27	0.786
_cons	-0.06638	-0.36	0.712	0.17131	1.38	0.168	-0.08626	-0.62	0.536
Sargan–Hansen (p-value)	0.1346			0.2503			0.0903		
AR(2) (p-value)	0.2510			0.9684			0.7284		
Obs. #	506			506			506		

Source: Authors' calculations in Stata 17. L1 is one year lagged of the dependent variable. Significance at: *p<0.10, **p<0.05, ***p<0.01

Mazur [32], Karadeniz et al. [27], Afza and Hussain [2], Shambor [47], and Moradi and Paulet [37], among others.

Liquidity has a significant negative relationship with LEV and STLEV at a level of 1% significance, but it has a positive significant effect on LTLEV at a level of 10% significance. Liquid telecoms do not need loans for working capital. Additionally, liquid telecoms use the generated funds to service their obligations, especially short-term ones, which affect total debt decrease. This is consistent with the POT's predictions. However, increasing liquidity can increase the firm's long-term borrowing capacity because excess cash can be used to pay interest on the debt. Ozkan [39], Mazur [32], Serghiescu and Vaidean [46], and Berkman et al. [5] came to the same findings for LEV.

The impact of GROS on LEV and LTLEV is positive and significant at a level of 5% and 1% significance, respectively. However, GROS has a significant negative impact on STLEV, at a level of 10% significance, meaning that sales growth provides current funds to settle daily business liabilities to some extent. We can conclude that telecoms do not have enough internal funds to finance their growth and must use additional external funds. Companies experiencing periods of high sales growth are encouraged to take on additional long-term borrowings to help them support and facilitate the growth. These findings correspond to the views of POT, and they agree with the findings of Črnigoj and Mramor [13], but they contradict the findings of Delcoure [16] and Alipour et al. [3].

As a measure of business efficiency, ASTUR has a positive effect on all three forms of leverage, but this effect is only significant on LEV and STLEV at the 1% significance level. More efficient telecom operators are looking for additional sources of financing, and it is easier reach for debt – more often, for short-term debt to bridge current obligations or meet current needs. Alipour et al. [3] and Berkman et al. [5] came to the same conclusion. In contrast, Viviani [52] and Feidakis and Rovolis [17] found a negative relationship between ASTUR and leverage.

The impact of NDTS on LEV and STLEV is negative and significant at a level of 5% significance. For a fixed level of profitability, which is accounted for by variable PROF, companies with higher levels of NDTS have stronger cash flow than their counterparts with low NDTS. This is due to the fact that depreciation is a non-cash expense. Therefore, they have less need to borrow cash. Furthermore, the significant influence of NDTS on the telecoms' capital structure can be explained by the shortened period of use for telecommunications equipment in telecoms' networks and the need to renew that equipment more often due to technological changes. Ozkan [39] and Cortez and Susanto [12] also found that NDTS has a negative association with LEV, but Delcoure [16], Shambor [47], and Moradi and Paulet [37] found that this relationship is positive.

The influence of COD on LTLEV is negative and significant at a level of 1% significance, and it has a non-significant negative impact on LEV. During periods of lower interest rates, companies are tempted to use leverage more intensely. However, COD has a positive significant impact on STLEV at a level of 10% significance. Increasing interest costs reduce the appetite for long-term borrowing. It is possible that difficult long-term borrowing opens up the need for short-term borrowing to regulate the firm's obligations. Similar to this study, analysing Indian firms in the period 2001–2010, Handoo and Sharma [23] found a negative significant impact of COD on LTLEV at a level of 1% significance, a negative but insignificant impact of COD on LEV, and a positive but insignificant impact of COD on STLEV. Teixeira and Parreira [49] and Mohanraj [35] reached similar findings.

The impact of the firm size and the country's GDP growth on all three types of leverage is positive and non-significant, while tangibility affects all three types of leverage negatively and non-significantly. Favourable economic circumstances (GDP growth) certainly have a positive impact on telecom operators' earnings. Larger companies have easier access to loans, which they often use, as shown in numerous studies. In our case, tangibility does not have a significant impact on the capital structure, possibly due to the specificity of telecommunications equipment and infrastructure (non-attractive collateral) but also to its decreasing share in the telecoms' total assets (average TANG is 0.40). Our results regarding the insignificant effect of TANG on leverage contradict most prior studies [27], [42], [46], [1], [8], [16], [18], [12], [37].

To decide which theory of capital structure best reflects the financial policy of the telecom operator, we created Table 5.

While both theories are supported by our findings, POT is more supported. Therefore, we conclude that POT explains more aspects of the observed behaviour of telecom operators in managing their capital structure than TOT does, making POT somewhat more relevant for the financial managers working in the telecom industry. This finding is consistent with Tamulyte [48], Mateev et al. [31], Berkman et al. [5], and Shambor [47], among others.

Conclusion

In this study, we investigated the impact of internal and external determinants of the capital structure of 46 European telecom operators in the period 2009-2020. The results of the conducted dynamic panel data analysis provide insight into how firm-specific and country-specific determinants affect the capital structure of telecoms and reveal which theory best describes the observed capital structure of European telecom operators. By providing answers to these questions, our research has fulfilled its goals.

According to the results of this research, the relevant determinants of the capital structure of European telecom operators in the period 2009-2020 were the following variables: annual sales growth, profitability, liquidity, assets turnover, non-debt tax shield, and cost of debt. Tangibility, firm size, and annual GDP growth did not significantly affect the capital structure of European telecom operators in the observed period. We found that total leverage and long-term leverage have a memory effect and significantly depend on their previous year values.

Annual sales growth, profitability, liquidity, assets turnover, and non-debt tax shield are significantly associated with total leverage. Profitability, liquidity, and non-debt tax shield have a negative association with total leverage, while annual sales growth and assets turnover have a positive association. To provide a more complete overview of the influence of various factors on the capital structure, we also considered their impact on the leverage components – short-term and long-term leverage. Assets turnover and cost of debt have a significant positive impact on short-term leverage, while liquidity, annual sales growth, and non-debt tax shield have a negative impact on short-term leverage. An increase in annual sales growth and liquidity leads to an increase in long-term leverage (positive effect), but an increase in profitability and especially the cost of debt causes a decrease in long-term leverage (negative effect).

The mentioned impacts mostly correspond to the assumptions of the pecking order theory of capital structure. In the past 10 years, telecom companies have operated stably and profitably; as such, they preferred to pay dividends to shareholders rather than interest on loans. They mainly financed their growth and development with internal funds characterised by high liquidity, stable sales growth, and sustainable profitability (retained earnings).

The main theoretical implication of this study is that both pecking order theory and trade-off theory are capable of explaining the observed effects of the selected factors on the capital structure of telecom operators. The fact that relatively more effects can be explained by pecking order theory does not mean that this theory should be chosen as the one that should prevail. On the

Table 5: The relationship between determinants and leverages – predictions of TOT/POT vs. results of study

Variables		GROS	LIQ	PROF	SIZE	TANG	ASTUR	NDTS	COD	GDPG	L1. Y
Expected relationship	TOT	-	+	+	+	+	+ / -	-	-	-	+ / -
	POT	+	-	-	-	-	+ / -	-	+ / -	+	+ / -
Results	LEV	+ **	- ***	- ***	+	-	+ ***	- **	-	+	+ ***
	STLEV	- *	- ***	-	+	-	+ ***	- **	+ *	+	+
	LTLEV	+ ***	+ *	- *	+	-	+	+	- ***	+	+ ***
Dominant CS theory	LEV	POT	POT	POT	tot	pot	?	?	tot	pot	?
	STLEV	TOT	POT	pot	tot	pot	?	?	POT	pot	?
	LTLEV	POT	TOT	POT	tot	pot	?	?	TOT	pot	?

Source: Authors' analysis (***- = significance at level 1%, **- = significance at level 5%, *- = significance at level 10%, + = positive impact, - = negative impact, ? = non-defined impact, TOT/POT = confirmed significant impact, tot/pot = confirmed non-significant impact, L1.Y is one year lagged of the dependent variable).

contrary, we prefer to interpret the findings in a way that supports the use of both theories and encourages their integration in a unified framework that would use the principles derived from both theories in a non-mutually exclusive manner.

This study has some limitations. First, our sample is limited to 46 firms, so the findings cannot be generalized to all the telecom operators. Second, the data are based on accounting reports, so the accuracy of our results depends on the accuracy of these reports. Third, our leverage measure represents the broadest measure of financial leverage. Total liabilities also include some non-financing liabilities, such as accounts payable, untaxed reserves, and trade credits, which, in certain cases, make the values of this ratio falsely inflated.

We can offer several proposals for future research: expand the sample of telecom operators, apply other appropriate empirical methods (e.g. hierarchical panel), take into account additional predictors (e.g. risk, earnings volatility) or different proxy of used predictors (e.g. GROWTH, LIQ, PROF), include additional relevant macroeconomic factors (e.g. interest rates), or analyse operators by groups with some common characteristics (e.g. developing and developed markets).

This study enriches the body of research on capital structure by providing relevant evidence about the capital structure of European telecom providers. Compared to other studies, apart from the number of analysed variables and the international approach, this study is also specific because it examines the influence of both internal and external factors on the capital structure. The results can help the management of telecom operators with setting their capital structure policy. The focus should be on determinants having a significant impact. The findings can also be used to determine whether the capital structure of any individual telecom operator is relatively (or even overly) aggressive or conservative, given the values of all the other relevant factors. This type of conclusion is difficult to draw in a predominantly objective manner outside of a statistical framework such as the one presented in this study.

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Saša Stamenković

is a PhD student at the Singidunum University, Faculty of Business Economics in Belgrade. He obtained his Bachelor's with Honours in Electrical Engineering from the University of Belgrade, School of Electrical Engineering in Belgrade, and Master's in Economics from the Singidunum University, Faculty of Business Economics in Belgrade. Saša works at Telekom Srbija a.d. He is a certified internal auditor and a certified designer of telecommunications networks and systems. He is author of more than ten professional papers on domestic and international conferences. His research areas of interest are corporate finance, business management, and financial analysis.

Nemanja Stanišić

is a Full Professor of Finance and the vice president at Singidunum University. He wrote his Ph.D. thesis in the field of Corporate Finance and defended it in 2010 at Singidunum University. Since 2018, he has been a Visiting Professor at the International College of the National Institute of Development Administration (ICO NIDA), Bangkok, Thailand. The main areas of his research include corporate finance, banking, audit and applied statistical analysis. He has published several dozen scholarly articles, many of which in top journals. He is the co-author of three academic textbooks and three workbooks. He served as editor-in-chief of the scientific journal The Journal of Applied Economics. He is a member of the scientific and organizing committees of several international conferences.

Tijana Radojević

is a Full Professor at the Faculty of Business Economics, Singidunum University in Belgrade. Her research focuses on finance and banking, e-banking and devising financial strategies in hospitality industry. Tijana's research papers have been published in various journals, such as Tourism Management, Cornell Hospitality Quarterly, Tourism Management Perspectives, Annals of Tourism Research, The European Journal of Applied Economics, Journal of Business Economics and Management, Economics of Agriculture, Ekonomika preduzeća, Teme. Also, she is a member of the scientific and organizing committees of several international conferences.