# Economic Growth and Firm Size Dynamics: Evidence from Romania's Development Regions

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*SUMMARY*

*The relationship between firms and economic growth is an intensely debated topic in the literature, emphasizing the impact of large businesses or small and medium-sized enterprises (SMEs) in ensuring growth, innovation and employment, as well as the role of support measures or social benefits. Although there is no consensus on the importance of each category in growth and development, there is tacit recognition that each size-class of firms has a series of specific characteristics that can more strongly influence certain aspects of development. A better understanding of these factors could help in adapting and calibrating measures and policies according to specific objectives, stages or geographical areas. In this paper, we propose an econometric approach to the relationship between economic growth (by GDP evolution) and the dynamics of firm sectors, by size class, at the level of the development regions of Romania. We found that the effect of the number of enterprises in each size class influences the GDP to a similar degree, regardless of the region, with a more pronounced positive impact in the case of micro- and small enterprises and ambiguous in the case of medium-sized enterprises.*

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## INTRODUCTION

In present times there is much diversity in GDP per capita levels in the world, with the differences between the richest and poorest economies being both striking and worrying, as these differences mean very different standards of living, opportunities and sometimes profound deprivation and inequality. Seeking to find out why economies perform so differently, numerous researchers have tried to understand to what extent certain characteristics of firms and their dynamics are related to the dimensions of the economy in which they are part.

The size of firms and the contrast between large businesses – few in number, but with considerable shares in employment, value added or geographical expansion – and the huge number of small businesses have led many researchers and policy makers to support a certain category of firms, invoking either the contribution in employment, in innovations' generation and diffusion, or the contribution to the reduction of inequalities and the rebirth of the entrepreneurial spirit. Nor have social or political arguments been forgotten, such as vulnerability and dependence on public support,

their role in social and community capital or political influence.

However, statistical data and various study results are quite contradictory in determining whether there are differences between small and large enterprises in terms of their impact on overall economic growth, employment, poverty reduction or boosting entrepreneurship. Some research shows that small companies make the most important contribution to new job creation (European Commission, 2023; Komarek & Loveridge, 2015; Shaffer, 2006), others put large companies in the foreground, especially through job stability and qualifications (Beck et al., 2005; Haltiwanger et al., 2010). Certain researchers support the viewpoint that the influence of the activity sector is decisive, for example in the services sector SMEs are much better represented and, implicitly, have a higher share of employment, but most of them offer jobs with low qualifications (Deller, 2010; Mansury & Love, 2008; Carneiro et al., 2020). In geographical and administrative contexts, it seems that small firms have greater importance in local development and the reduction of poverty and inequalities, stimulating cohesion and local initiatives (Badulescu et al., 2024; Gubik, 2020), while large firms have a more relevant contribution at the national level, through contributions to employment, income to the state budget, spreading technology and supporting research and development activities.

This paper aims to fill a gap in the national and European academic literature, analysing the relationship between business size and regional economic development in a European Union member country, namely Romania. Thus, the structure of the article is as follows: after this introduction, the literature review section follows, and the subsequent sections (third and fourth) are for the methodology and for the analysis of the results and discussion, respectively. Finally, the main conclusions and policy recommendations are presented.

## THE LITERATURE

The main literature on firm size and its impact on the uneven development of economies suggest that disparities in business size, organizational structure, and workforce qualifications contribute to economic differences between rich and poor countries. In the next subsections we will present a review on this topic, but also on the role of small and large firms in economic growth, examining how the distribution of firm sizes influences overall economic performance.

### *Firm size and the uneven development of economies*

An important part of the literature explores the uneven level of development of the world's economies by the large differences in the size of businesses, organization and qualifications of the employed labour force. First of all, firms in poor countries tend to be, as a rule, much smaller than those in rich countries. Bento and Restuccia (2021), analysing the complete distribution of firm sizes in several countries, found that a 10% increase in GDP means, on average, an increase of about 3% in the size of firms (as number of employees). Second, not only the number but also the form of organization can explain these differences - firms in poor countries often tend to be sole proprietorships or family firms, while in rich countries the percentage of firms organized as joint stock companies is substantially higher, and this percentage gradually increases with the increase in GDP per capita (Majerovitz, 2023). Finally, not only the number of employees, but also their qualifications and education matter: the average share of workers who have graduated from high school or higher education varies by GDP per capita, showing considerable differences. According to Majerovitz (2023), companies in the manufacturing sector in developed European countries have, on average, more than 80% of employees with at least a high school education, compared to only 55% of workers in companies in African developing countries.

A less friendly business environment, various pressures and reduced security mean that many firms in developing countries avoid registration or declare turnover figures that are much lower than reality. According to La Porta and Shleifer (2014) the informal nature of economic activity is very widespread in less developed economies: in poor countries around 35% of GDP comes from informal firms, while in richer countries (i.e. those in the first quarter of the group of countries ordered by GDP) the percentage is below 17% (La Porta & Shleifer, 2014; Majerovitz, 2023).

We must note that these differences show the state of affairs, but the explanations of the differences and links with economic development are still quite complicated. The fact that less developed countries are characterized by a business sector dominated by small business sizes, an informal sector, basic organization structures and low employee qualifications may reflect deeper problems.

Bento and Restuccia (2017) connect the small size of firms in poor countries to a lack of interest in investment and technology, fuelled by the uncertain economic environment that threatens their expectations of the profitability of such investments. Akcigit et al. (2021) find that individual and family firms, although suited for survival and resilience in uncertain or hostile economic and political environments, cannot grow because their managers are not selected on the basis of competence but on the basis of family ties.

## *The effect of firm size distribution on economic growth*

In general, the relationships between economic growth and firm size have been widely discussed in the literature, but most papers have focused on specific parts of the distribution, either micro- and small firms, or large firms, and quite a few have addressed the particularities of the entire distribution of firms by size class. Much of the literature has also argued that explanations have to consider, in the same models, other important factors of economic growth.

The first approaches to the relationship between economic growth and the size distribution of firms can be found in Schumpeter's 1934 *Theory of Economic Development* (1961), which describes the small innovative entrepreneur as the driving force of economic development, competing with existing firms by introducing new innovations, thereby making current technologies, goods or services obsolete. The importance of small firms over large companies, which are consolidated but often lacking in flexibility and willingness to renew, is described in the well-known expression "creative destruction". Later in Schumpeter's work, in *Capitalism, Socialism, and Democracy* (Schumpeter, 1942), he describes the dominance of large firms over small firms, advantaged by their considerable financial and human resources and the ability to use the innovations resulting from the activity of research and development, the so-called "creative allocation" process, specific to the first half of the 20th century. Interestingly, economic growth at the end of the 20th century in developed countries according to many researchers and statistical findings, was closer to the first Schumpeter's model (Carree et al., 2002), as the share of small enterprises in production industrial, trade, creation of added value, employment, but also in innovation and research and development was increasing (Acs & Audretsch, 1987). Since then, numerous studies argue that an economy with a higher proportion of SMEs is more efficient, or, reciprocally, that a poorly developed SME sector (quantitatively, but also qualitatively) would explain the poor performance and reduced dynamism of many world economies (Carree & Thurik, 1998; Audretsch et al., 2000).

There are, however, numerous contributions based on more recent data that support the importance of large firms in generating economic growth in modern-day economies. For example, Lee et al. (2013) showed that a 1% increase in the number of top firms led to a significant increase in growth rates in most developed and developing countries. According to their research, large enterprises, which are much smaller in number but with a greater contribution to the creation of added value, have a clearer and stronger effect on economic growth compared to SMEs. The relatively large number of employees compared to turnover and the volume of investments and non-existent budgets for research, development and innovation in the vast majority of SMEs indicate a limited possibility for influencing GDP growth (Dianu et al., 2019). Autor et al. (2020) advance a theoretical model of "superstar firms", starting from the premise that tougher competition increases the advantages of more innovative and productive firms, which become dominant "superstars" over time. The increase in competition has gone hand in hand with the increase in concentration in certain industries, which have become relatively more productive and innovative, with significant decreases in labour costs in total expenses. According to Poschke (2018), economic development also generates significant changes in the size distribution of firms, and the average size of large firms in rich countries has increased simultaneously with their size dispersion. The growth of entrepreneurial firms is strongly conditioned by the adoption of technical progress and the development of entrepreneurial skills.

Starting from the fact that the size of the firm is relevant and can be considered as a relevant factor for the growth and development of a region, Shaffer (2006) recommends that political decision-makers understand these relationships to influence regional development according to the most favourable effect of each size category on growth and, of course, on the strategic objectives of each stage.

However, certain researchers and studies assert that, while in developed countries SMEs are associated with faster income growth (Amaghouss & Ibourk, 2013; Audretsch & Thurik, 2001; European Commission, 2023; Shaffer, 2002), in developing countries and regions with weak institutions, the role of small businesses is ambiguous (Acs & Audretsch, 1987; Carree et al., 2002; Carree & Thurik, 1998; Dejardin & Fritsch, 2011; Deller, 2010). In developed countries SMEs are considered to be the most important factor of regional GDP growth (Komarek & Loveridge, 2015), a key factor in explaining variations in output across region (Gubik, 2020), but also a precondition for regional economic progress in developing countries (Glonti et al., 2021), while Yang (2019) considers that the level of regional development is important for the growth and performance of companies, but it is overshadowed by the role of investors and managers.

Cravo et al. (2012) show that although firm size plays an important role in regional economic development, the results are uneven, depending on the sector, time frame and methods of measurement. Carneiro et al. (2020) find that industrial sectors display a strong relationship between firm size and regional economic growth, while the relationship is statistically significant and negative for service sectors. All categories of companies (by number and global size) negatively influence poverty indicators. Interestingly, small firms and especially microenterprises in the tertiary sector have a negative effect on income growth, but a positive effect on regional employment.

Regarding the recent literature on this topic in the case of Romania, although we find numerous studies on the relationship between the dynamics of SMEs and GDP growth (Armeanu et al., 2015; Simut et al., 2021; Stelea & Calefariu, 2022), the regional perspective and, in particular, the structure by size classes of firms related to economic growth has been analysed (Badulescu et al., 2024; Druica et al., 2017; Gavrilut et al., 2022; Goschin, 2014). In a sectoral approach to this relationship, Stancu et al. (2021) determined that for the period 2007–2015 the influence of firm size on growth was negative and significant, which would suggest that small firms grow faster than large firms, and other variables (such as the level of taxation) also have a significant influence on the growth of firms, but not investments in research and development (especially in the case of small and medium-sized firms).

Of course, the international literature on the topic of economic growth states there are other important variables that influence economic growth, beyond the distribution of firm size, including the dimensions, dynamics and liberalization of the financial sector (Levchenko et al., 2007), participation in international trade, innovation (Piguillem & Rubini, 2012) and the regulatory environment associated with the labour market (Loayza et al., 2005). In addition, tax burden, trade barriers, bankruptcy and contract enforcement are undoubtedly important factors in the growth (or stagnation) of an economy.

## METHODOLOGY

Based on the previous literature, in the present work we started from the hypothesis that the dynamics and performance of an economy are determined, among other factors, by the number of companies active in that economy, and we propose to test this hypothesis by analysing the existence of links between the evolution of the number of registered companies (by size class) and change in GDP, at the level of the development regions of Romania (NUTS2), a European Union member state. The data were obtained from the National Institute of Statistics of Romania (NIS Romania) and from Eurostat.

Romania consists of eight development regions (NUTS2 level, see Figure 1), ordered according to GDP/capita as follows: the capital region, namely the Bucharest–Ilfov Region, with over 28,400 EUR/capita, West Region (12,200 EUR/capita), Centre Region (11,600 EUR/capita) North-West Region (10,500 EUR/capita), South-East Region (10100 EUR/capita), South-West–Oltenia Region (9400 EUR/capita), South–Muntenia Region (9390 EUR/capita) and North-East Region (7900 EUR/capita) (NIS Romania, 2024; Badulescu et al., 2024).

As for the number of enterprises, it grew constantly, but quite slowly during the analysed period (2008 to 2021), from around 555,000 in the years 2008–2010 to around 671,900 in 2022. Almost a quarter of the total number of companies registered in Romania (24.1%) are in the Capital Region, Bucharest-Ilfov, followed by the North-West Region (15%), Centre, North-East, South-East, South-Muntenia (between 11% and 12%, each), while the South-West and North-East regions have the lowest percentages, between 7% and 9% each. By size class, the figures are quite similar across regions; however, the situation of large enterprises (with over 250 employees) is worth noting: the capital region holds over a third (36.2%) of the total number, while the next two regions (Centre and North-West) each contain about 11% of the total (NIS Romania, 2024).


Source: Popescu & Popescu (2011)

*Figure 1. The development regions of Romania*

In this paper, we aim to take an econometric approach to examine the relationship between economic development (reflected by GDP growth) and the dynamics of the business sector from a regional perspective.

To begin with, we build a multiple linear regression to investigate the relationship between the GDP evolution and the structure of companies, categorized by size, for each development region of Romania and at the national level. More precisely, we intend to find out which categories of company size influence (and to what extent) the economic development of a region. At the level of the European Union, the structure of the company sector (by size class) is strongly unbalanced: there is an overwhelming share of micro-enterprises (92-93% is the EU average, 88-89% for Romania) (Eurostat, 2024) and relatively insignificant percentages of medium and large companies. On the other hand, in all EU countries, including Romania, the contribution of large companies is considerable, both in quantitative terms – gross added value (over 48%), employment (35.6%), and turnovers – but also qualitative (European Commission, 2023).

Thus, we considered GDP (in million RON) as the dependent variable and independent variables were MICRO (Micro-enterprises, firms with 0 to 9 employees), SMALL (small enterprises, with 10 to 49 employees) and MEDIUM (medium-sized enterprises, between 50 and 249 employees) (European Commission, 2003; OECD, 2020). The analysis covers the period from 2008 to 2021, during which comprehensive data for all indicators and regions were available (Eurostat, 2024; NIS Romania, 2024).

The augmented Dickey-Fuller (ADF) test, regarded as the least affected by insufficient data among common unit root tests such as ADF, PP, and KPSS (Choi, 2001; Im et al, 2003) was initially applied to the original series. If no significant results were obtained, the test was then performed on the first differenced series to determine the order of integration: I(0), I(1), or other. The test was not applied after the second differencing due to the low statistical power of such tests, which would be further compromised by the reduction in series size.

The test was performed with lags between 0 and 4 (larger lags decrease the power of the test). Also, the ADF test can be performed according to 3 methods: without deviation (drift) and without linear trend (trend), with deviation but without linear trend, with deviation and linear trend. Thus, the first model corresponds to an equation of the form $y_t = \rho \cdot y_{t-1} + \varepsilon_t$ (stationary with mean 0), the second to an equation $y_t = \alpha + \rho \cdot y_{t-1} + \varepsilon_t$ (stationary with non-zero mean/stationary at level), and the last method corresponds to $y_t = \alpha + \beta \cdot t + \rho \cdot y_{t-1} + \varepsilon_t$ (stationary around a straight line/trend-stationary).

## RESULTS AND DISCUSSION

These results are summarized in Table 1 for the model yielding the most significant results (the most negative ADF).

*Table 1*

*Augmented Dickey-Fuller test results for GDP, MICRO, SMALL and MEDIUM time series*

| | GDP | | | MICRO | | | SMALL | | | MEDIUM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Order/ Method** | **ADF** | **P** | **Order/ Method** | **ADF** | **P** | **Order /Method** | **ADF** | **p** | **Order/ Method** | **ADF** | **P** |
| National | 1 (D+T) | -3.61 | 0.04 | 0 (D+T) | -5.01 | <0.01 | 0 (D+T) | -16.82 | <0.01 | 0 (D+T) | -6.20 | <0.01 |
| North-West | N/A | -2.98 | 0.20 | | -4.55 | <0.01 | 0 (D) | -6.65 | <0.01 | 0 (D+T) | -11.94 | <0.01 |
| Center | N/A | -1.86 | 0.61 | | -4.10 | 0.019 | 0 (D+T) | -5.04 | <0.01 | 0 (D+T) | -6.79 | <0.01 |
| North-East | N/A | -2.62 | 0.32 | | -4.20 | 0.016 | 0 (D+T) | -3.79 | 0.03 | 0 (D+T) | -5.24 | <0.01 |
| South-East | N/A | -2.5 | 0.15 | | -4.87 | <0.01 | 0 (D) | -10.74 | <0.01 | 0 (D+T) | -5.26 | <0.01 |
| South - Muntenia | N/A | -3.21 | 0.11 | | -3.60 | 0.049 | 0 (D+T) | -8.52 | <0.01 | 0 (D) | -4.58 | <0.01 |
| Bucharest–Ilfov | N/A | -3.13 | 0.13 | | -8.56 | <0.01 | 0 (D+T) | -4.41 | <0.01 | 1 (D+T) | -6.82 | <0.01 |
| South-West Oltenia | N/A | -1.19 | >0.87 | | -3.99 | 0.023 | 0 (D) | -4.45 | <0.01 | 0 (D+T) | -10.1 | <0.01 |
| West | N/A | -1.73 | 0.66 | | -4.41 | <0.01 | 0 (D+T) | -4.36 | 0.01 | 1 (D+T) | -4.17 | 0.01 |

Notes: Order – Order of differencing, ADF – Augmented Dickey-Fuller test statistic, N/A – stationarity is not obtained even after the first difference (the lowest ADF and p value obtained for the differenced series are mentioned). The methods are: D (with deviation, no linear trend), D+T (with deviation and linear trend).

Source: our calculations

The results for the MICRO series are relatively consistent across regions, as the series are all trend stationary. However, the SMALL series shows less consistency, displaying a mix of trend- stationary and level-stationary patterns. For the MEDIUM series, the results vary: in the Bucharest–Ilfov and West regions, the series exhibit a unit root and become trend-stationary after the first differencing; in the South–Muntenia region, the original series is level-stationary, while in the remaining regions, it is trend-stationary.

At the national level, the GDP series is not stationary at level but becomes stationary after the first differencing, indicating an integrated process of order 1 (I(1)). However, at the regional level, the series remains non-stationary even after the first differencing, regardless of the method applied, suggesting a more complex structure or a higher order of integration. Considering this fact, we tried to repeat the tests on the logarithmic lnPIB series. Some series appear to be trend-stationary after the first difference at a confidence level of 0.05 (North-East and Bucharest–Ilfov), others only at a confidence level of 0.10 (national, Centre, South–Muntenia), the series South-East is trend-stationary as such, and the rest (North-West, South-West Oltenia and West) are not stationary even after the first difference, according to any method. Thus, we conclude that, at a confidence level of 0.1, the Total (national), Centre, North-East, South–Muntenia and Bucharest–Ilfov series are I(1), the South-East series is I(0), and the others are integrated to a higher order.

Given the heterogeneity of these results, which are likely affected by the application of low-power tests to small series, we chose to build a multiple linear regression model, restricting ourselves to the original, non-log and undifferentiated series in the first place due to the simplicity and ease of application of diagnostic tests. For example, the existence of a spurious regression phenomenon, although it is expected in the case of non-stationary series with similar evolution, can be identified post hoc by a significant result of the Durbin-Watson test for the autocorrelation of the residual variable (Granger & Newbold, 1974).

Thus, we applied the following model to each region:

$$GDP_t = \beta_0 + +\beta_1 \cdot MICRO_t + \beta_2 \cdot SMALL_t + \beta_3 \cdot MEDIUM_t + \varepsilon_t \quad (1)$$

The results are presented in Table 2 in the following format: independent variable (p-value for t-test), adjusted R-squared, F-statistic for OLS model (p-value).

*Table 2*

*Analysis of GDP using firm size distribution by region*

| | **Intercept (p)** | **MICRO (p)** | **SMALL (p)** | **MEDIUM (p)** | **$R^2$** | **F statistics (p)** |
|---|---|---|---|---|---|---|
| National | $-2.06*10^6$ (0.008) | 2.46 (0.017) | 68.96 (<0.001) | -194.7 (0.003) | 0.849 | 19.8 (<0.001) |
| North-West | $-3.94*10^5$ (<0.001) | 2.52 (<0.001) | 73.08 (0.001) | -176.1 (0.0095) | 0.871 | 23.51 (<0.001) |
| Centre | $-2.27*10^5$ (0.042) | 1.95 (0.019) | 70.16 (0.0035) | -200 (0.0034) | 0.745 | 10.74 (0.005) |
| North-East | $-1.88*10^5$ (0.0018) | 2.19 (<0.001) | 48.67 (<0.001) | -125.7 (0.00115) | 0.885 | 26.62 (<0.001) |
| South-East | $-1.13*10^5$ (0.046) | 1.82 (0.003) | 47.19 (<0.001) | -179.4 (<0.001) | 0.893 | 28.86 (<0.001) |
| South–Muntenia | $-1.042*10^5$ (0.064) | 1.24 (0.033) | 60.44 (<0.001) | -203.1 (0.0043) | 0.866 | 22.59 (<0.001) |
| Bucharest – Ilfov | $-7.02*10^5$ (0.041) | 2.85 (0.020) | 75.30 (0.027) | -115.7 (NS) | 0.685 | 8.24 (0.011) |
| South-West Oltenia | $-1.056*10^5$ (0.053) | 2.66 (0.004) | 42.35 (0.006) | -139 (0.007) | 0.7969 | 14.08 (0.002) |
| West | $1.36*10^5$ (NS) | 2.16 (0.046) | 26.53 (NS) | -157 (0.030) | 0.4258 | 3.47 (0.079) |

Source: our calculations

It can be seen that the model poorly performs for the West region (the F-test result is not significant at the 0.05 confidence level), but for all other regions and at the national level, the results are acceptable and comparable. The most notable and challenging finding to explain is the negative correlation between the number of medium-sized firms and GDP across all regions. In other words, in all regions (with the

exception of the West Region, where the model lacks statistical significance), an increase in the number of medium-sized enterprises is associated with a decrease in GDP.

Regarding the effect of the number of micro-enterprises (MICRO), it is more significant in the Bucharest–Ilfov Region, and the weakest in the South–Muntenia Region. Regarding the effect of small firms (SMALL) on GDP, we note again the maximum value for the Bucharest–Ilfov region, and the weakest effect in the West Region (but here the coefficient is not statistically significant), and respectively in the South-West Oltenia Region. In the case of medium-sized companies (MEDIUM), first of all, we note that their effect is negative, and the strongest effect (in absolute value) is registered in the South–Muntenia and Centre Regions, and the weakest in the Bucharest–Ilfov Region.

Regarding the value of R2, very high values are generally recorded (except for the West Region), which, on the one hand, can be interpreted as a large part of the GDP variation being due to the variation in the number of companies, but, at the same time, it is more likely a consequence of ignoring the trend of the time series (i.e. during the analysed period, the GDP value and the number of companies had a similar evolution, of relatively continuous growth).

To confirm that the model, despite neglecting the assumptions characteristic of time series regression, is nevertheless useful for forecasting, a series of diagnostics were performed: autocorrelation of the residual variable, heteroscedasticity, normal distribution of the residual variable, and variance-inflation factor (for multicollinearity). Results are presented in Table 3.

Heteroscedasticity was tested using the White test, normality of residuals using the Shapiro-Wilk test (which is considered appropriate for short series), and finally autocorrelation of residuals using the Durbin-Watson test. Multicollinearity was estimated using the variance-inflation factor (VIF).

We can conclude that the models are generally suitable for making predictions. No model shows residual heteroscedasticity, the residuals are normally distributed (with the possible exception of the model for the Southeast Region), and the predictor terms (the independent variables) do not appear to depend on each other, with the possible exception of the model for the North-West, in which case the number of medium enterprises is somewhat correlated with the other predictor variables.

The main problem is the positive serial autocorrelation of the errors, evidenced by a Durbin-Watson statistic below 2 and a significant p-value, in the case of the Centre, Bucharest–Ilfov and West Regions. However, the small sample size and the decision to neglect non-stationarity in the original time series indicate that the problem may also apply to the model calculated for the other regions. At the same time, the DW statistic is never less than R2, an empirical "test" for severe spurious regression situations mentioned by Granger and Newbold (1974).

*Table 3*

*Diagnostic regression tests for linear models*

| | | | | **VIF** | | |
|---|---|---|---|---|---|---|
| | **Homoscedasticity of the residual variable - White statistic (p)** | **Normality of residuals: Shapiro-Wilk statistic s(p)** | **Autocorrelation of residuals - DW statistic (p)** | **MICRO** | **SMALL** | **MEDIUM** |
| National | 9.234 (0.161) | 0.938 (>0.1) | 1.871 (>0.1) | 1.200 | 1.183 | 1.350 |
| North-West | 8.496 (0.204) | 0.893 (>0.1) | 1.786 (>0.1) | 2.034 | 2.316 | 3.788 |
| Centre | 6.324 (0.388) | 0.962 (>0.1) | 1.479 (0.043) | 1.261 | 1.211 | 1.440 |
| North-East | 8.568 (0.199) | 0.907 (>0.1) | 2.131 (>0.1) | 1.276 | 1.109 | 1.364 |
| South-East | 10.449 (0.103) | 0.869 (0.075) | 2.772 (>0.1) | 1.197 | 1.047 | 1.202 |
| South–Muntenia | 3.569 (0.735) | 0.947 (>0.1) | 1.617 (0.058) | 1.134 | 1.598 | 1.444 |
| Bucharest–Ilfov | 4.409 (0.621) | 0.935 (>0.1) | 1.3375 (0.028) | 1.576 | 1.243 | 1.578 |
| South-West Oltenia | 2.814 (0.832) | 0.963 (>0.1) | 1.684 (0.095) | 1.007 | 1.003 | 1.005 |
| West | 5.376 (0.496) | 0.922 (>0.1) | 1.375 (0.023) | 1.110 | 1.287 | 1.359 |

Source: our calculations

In Table 2, the value of the regression coefficients, although of the same order of magnitude, tends to differ somewhat between regions. In an attempt to identify whether regions can be clustered according to the impact of a certain number of firms on GDP, k-means clustering was performed for the MICRO, SMALL and MEDIUM coefficients after normalization. All significant models were analysed (less for the West Region), grouping the regions into three clusters (groups), calculated by the silhouette method, the average of each cluster being interpreted below:

a. The moderate impact of micro-enterprises, the low impact of small companies, the moderate impact of medium-sized companies on GDP in the following Development Regions: North-East and South-West Oltenia;

b. The high impact of micro-enterprises and small companies, and respectively the moderate impact of medium-sized companies in the North-West and Bucharest–Ilfov Development Regions;

c. The low impact of micro-enterprises, the moderate impact of small companies, and, respectively, the low impact of medium-sized companies in the Centre, South-East and South–Muntenia Development Regions.

It can be concluded that, in certain regions, such as the South-East and South–Muntenia, GDP is less influenced by the number of small firms and micro-enterprises, while the negative impact of medium-sized firms on GDP is also less significant. Conversely, in the North-West and Bucharest–Ilfov regions, the number of small and micro-enterprises exerts a stronger influence on GDP growth, whereas the effect of medium-sized firms presents a more modest negative impact on GDP dynamics.

## CONCLUSIONS

The literature has intensively analysed the relation between economic development and systematic changes in the firms' size distribution. Several contributions assert that in rich countries the average dimensions and dispersion of firms are larger than in developing countries, but also that the internal (organizational forms, staff qualifications) or external characteristics, such as the quality of the regulatory environment, matter a a great deal in the relationship between firm size and the growth of national economies. However, most of the studies focused on certain components of the structure of firms by size class – favouring either micro-enterprises, or the whole SME group, or large firms. Numerous researchers have shown that focusing on identifying relationships between size class structure and GDP growth is rather unproductive, as long as other economic, social, political or cultural factors are proven to matter for economic growth.

In our analysis on Romania development regions, we found that, in general, the effect of the number of enterprises in a particular category similarly influences GDP, regardless of region, at the 0.1 confidence level. It is observed that the number of micro-enterprises and small enterprises positively influences GDP; the number of small enterprises, however, has a greater effect by an order of magnitude (10 times higher) than micro-enterprises, while the number of medium-sized enterprises has an effect even stronger, but negative, except for the Bucharest–Ilfov region, where the number of medium-sized companies does not significantly influence GDP.

Although the assumptions of the linear model were ignored, the testing of the residual variables for homoscedasticity, normality and autocorrelation do not indicate significant deviations, except for the Centre, Bucharest–Ilfov and West regions. As for multicollinearity, measured as variance inflation factor, we consider that it is not severe in any region, but it should be remembered that for this parameter (VIF) there is no threshold value. Applying a clustering algorithm (k-means clustering) to the coefficients of the MICRO, SMALL and MEDIUM explanatory variables in the case of the seven regions that have significant patterns (so not including the West Region), we can cluster the regions into three categories:

a. GDP less influenced by the structure according to the size class of the companies, in the Centre, South-East and South–Muntenia Development Regions;

b. GDP influenced mainly by the number of micro-enterprises (in a positive sense), but, simultaneously, also by the number of medium-sized companies (in a negative sense), in the North-East and South-West Oltenia Regions;

c. GDP influenced especially by the number of micro and small companies, in the North-West and Bucharest–Ilfov Regions.

However, although the effect of the number of firms on GDP seems more favourable in the case of the Bucharest–Ilfov and North-West Regions, the coefficients have similar values in all regions (a positive but relatively small effect for the number of micro-enterprises and small firms, respectively a larger but negative effect for the number of medium-sized firms), suggesting that the differences, even if they exist, are not strong.

Current models and research also have a number of limitations. Thus, due to a limited number of values, it was not possible to test the premises of the regression applied to time series (especially the stationarity of the GDP series). Also, the GDP series is not stationary at the level, nor does applying the 1st or 2nd order difference achieve stationarity. Also, for this reason, it is possible that the diagnostic tests that should have signalled the consequences of ignoring these deviations (especially the Durbin-Watson test for the autocorrelation of the

residuals) did not have sufficient power, i.e., generated false negative results, the models being in reality unusable for predictions.

On the other hand, we started from the premise of a linear model (1), but a nonlinear model, such as a quadratic or logistic regression model, could have better represented the involved phenomenon. We note, however, that even in the case of log(GDP), the series does not become stationary after the first and second differences.

Further understanding of the differences between firms, as well as the causal links between their size structure and economic development, can help to underpin economic policies by contributing to the increase of firms' performance, supporting those characteristics specific to each class of firms by size in order to enhance more accelerated and comprehensive growth in certain periods of time, economic sectors or regions.

## *Author's contribution*

The authors declare they equally contributed to this article: conceiving and designing the study; collecting the data; performing the analysis; writing and reviewing the paper

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