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Reducing Uncertainty in Romanian Public Finances: Forecasting Models for Revenue Collection

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Abstract

Although practitioners (decision makers or public servants) can choose between different estimation techniques and models, data availability as well as their limited knowledge will often reduce the number of models which can be effectively used to forecast revenue collection. Going beyond a theoretic review of these methods and based on the assumption that time series analyses are the best balanced alternative from the perspective of accuracy (benefits) and resource usage (costs), the paper will inquire which technique can be used in order to estimate the levels of local revenue collection in Romania. As such, three time-series analyses, namely the Simple Moving Average (SMA), Exponential Smoothing (EXS) and Transformation Moving Average (TMA) are used to create estimates for 2011 based on revenue collection levels of 3228 Romanian territorial - administrative units for the 2008-2010 periods. In order to identify which of the three best fits the data, the estimates made with SMA, EXS and TMA were compared (in SPSS using the Paired sample T Test) with the actual 2011 data. Since the difference between the TMA estimates and the actual data are the only ones that are not statistically significant, the paper argues that the TMA is the best fitted time series techniques for this particular type of data. Furthermore, in order to assess the accuracy of the TMA as a medium term forecasting technique, revenue collection levels will be analyzed according to the type of community for both for the actual 2008-2011 data and a predicted (2012-2015) period.

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1. Introduction: revenue collection in Romania

In order to ensure an adequate financial management of local communities, financial decision makers (elected officials and public servants alike) are often required to estimate or forecast different economic and financial indicators that refer to the local community (at large) and their own institution (in particular). Beside expenditures, one of the most important financial indicators that must be estimated (at least on yearly bases) refers to the revenues that will be at the disposal of local authorities and which can be used as crucial resources for providing public goods and services that best fulfill the citizens' needs.

The interest of local (and national) public institutions in developing reliable estimates is two-fold, as accurate revenue estimates are essential to allocate the maximum potential funds in the pursuit of different policy objectives, while confidence that designing a budget after such estimates will not lead to fiscal problems (especially deficits) is crucial (Howard, 1989, p. 1).

Hye and Jalil (2010, pp. 22-28) analyzed Romanian national government expenditures and revenues (as a percentage of GDP) from the first trimester of 1998 to the third one of 2008 (via autoregressive distributive lag) and identified that a 'bidirectional long run causal relationship exists between the expenditure and revenue of government' (p. 28), thus highlighting the interconnectedness of the two major aspects of public finances.

Gyorgy, Mândrean and Gyorgy (2011, p. 118) divide local revenues in two different categories, namely: (1) taxes and fees which can be collected by the local authority (this includes grants from central budgets) and (2) fees for services that can be collected by each provider of local public services. The Institute for Public Policies highlighted that a cleavage seemed to be developing even before 2000 between local communities that manage to obtain sufficient revenues from own sources and those that do not have enough revenues even for paying their utilities bill (Institutul pentru Politici Publice, 2001, p. 9). While economic, social and demographic advantages offer enough resources for some communities to undergo a continuous and equilibrated development, others are both less fortunate and blamed for their inability to collect local resources (even when the tax base is not always present); thus rich communities lose sight of the primordial European concept that development is built on economic and social cohesion (Institutul pentru Politici Publice, 2001, p. 9) and not on assigning blame.

Bunescu and Mihaiu (2010, pp. 332-337) analyzed tax revenues according to GDP and tax burden between 2000 and 2009. According to the authors (p. 334), positive economic growth (GDP increase) is followed by the same effect on the tax revenues collected, even if elasticity is not monotonous. Similar views are expressed by Şerban and Talpoş (2010, pp. 307-314) which observed that the high taxes of 2000-2004 did not lead to higher government revenues, while post 2004 policies (closure or privatization of state enterprises, strengthening fiscal control and relaxing taxation) did lead to higher public revenues (as a percentage of GDP). Dobrotă and Chirulescu (2012, pp. 63-68) however reach a different conclusion when analyzing the relationship between the tax burden and annual tax income for the 1991-2009 period. According to the authors (2012, p. 65) in '1998, 2005, 2006, 2007 and 2008 taxation in Romania stood in the Laffer curve inadmissible area', thus contradicting previous findings. Furthermore, over this period, differences in the Laffer curve were also observed when taking into account the consolidated general budget and the state social security budget (Dobrotă and Chirulescu, 2012, pp. 66-68).

Such discrepancies can be explained by either different methodologies (used in these studies) or by the fact that public finance data can differ depending on its source. However, Inceu et al. (2010, pp. 71-85) argue that compared to other EU member states, Romania has an overall lower tax pressure; in theory this should lead to a higher willingness to pay taxes and ultimately to bigger local and central budgets. Oprea, Bilan and Stoica (2012) argue that the continuously increasing pre-crisis public revenues pushed aside possible concerns for diminishing tax evasion and increasing resource management and control efficiency, thus increasing the institutional vulnerabilities of Romanian fiscal authorities (especially concerning the VAT and social contributions).

Braşoveanu and Obreja Braşoveanu (2013, pp. 167-184; 2009, pp. 133-142) and Braşoveanu (2010, pp. 91-102) draw attention that corruption will negatively affect revenue collection. Iorga, Moraru and Giosan (2010, p. 6) argue that political pressure and discretionary power (at the central level) can be used to supplement certain local budgets for political and electoral goals, thus skewing the distribution of local revenues between different territorial-administrative units.

Revenue transaction processing remains labor intensive and 'the current reporting systems and processes heavily rely on manual intervention for collection, verification and validation of financial information, limiting timely operational reporting and analysis', while revenue information and processing remains unreliable, suffering timing issues and lacks details (The General Secretariat of the Government, 2010, p. iv), despite multiple reform attempts.

In order to separate policy formulation from implementation for the sake of 'greater accountability and more focused organizational arrangements', the operational tasks pertaining budget execution and revenue administration have been transferred to an autonomous agency (namely the National Agency for Fiscal Administration) (The General Secretariat of the Government, 2010, p. 9; Barand, Ross and Harrison, 2004, p. 17). However, Gyorgy, Mândrean and Gyorgy (2011, p. 119) draw attention that 'local authorities get monthly majority of financial resources directly from the National Fiscal Administration Agency which is responsible with collecting major taxes (income tax, VAT, corporate tax etc.)' which would represent an infringement (or at least limitation) on the principle of financial decentralization, as local authorities are not directly responsible for collecting most of their revenues. Instead, they are limited to property taxes (on buildings, lands, and cars) and building permits (Gyorgy, Mândrean and Gyorgy, 2011, p. 119), which would mean that the revenues directly available to local authorities are influenced by the size of the community and its prosperity (or growth).

Regarding other institutional and process attempts in order to increase revenue collection, Barand, Ross and Harrison (2004, p. 45) praise the governmental decision of 2003 to integrate social contribution collection and tax administration in a single system in order to: (1) improve administrative efficiency and provide better services by centralizing (and rationalizing) a fragmented collection services the enforcement activities undertaken in multiple different agencies, and (2) increase compliance and collection regarding tax and social contribution.

According to the General Secretariat of the Government (2010, p. 42) compliance policy for the small taxpayer segment should involve measures such as: abolishing small and inefficient taxes and levies; developing third party information flows; providing taxpayer services and education; diminishing the number of tax returns and payments and facilitate e-filing. Iorga (2010, p. 69) identifies another set of measures considered efficient in increasing the revenue collection level for local taxes: offering bonuses and facilities for tax payers that pay their contributions until a certain time; implementing an online system of tax payment, and developing an efficient and credible communication system with tax payers.

The modern and more technologically advanced electronic payment system, alongside more traditional means is brought up by Gyorgy, Mândrean and Gyorgy (2011, p. 119) and Petruşel (2006, p. 108) as a feasible way to increase voluntary compliance and revenue collection.

Furthermore, the modernization of revenue administration (by strengthening compliance policy, reducing administrative and compliance costs) was identified by The General Secretariat of the Government (2010, pp. ii-iii, vi) as one of the eight reform areas that directly address performance challenges of Romanian public finance, while 'unrealistic revenue estimates' were singled out as the source of the national's budget lack of credibility (thus influencing macro-economic discipline).

Institutionalized prudent revenue estimations were also identified as a short term reform option with a critical impact on macro-balance discipline (The General Secretariat of the Government, 2010, p. iii). All things considered, Romanian public finance estimates for both revenues and expenditures are still unreliable, thus constituting a possible cause of multiple deficiencies in Romanian public finances.

Regarding revenue collection in Romania, the aim of this research is to identify the best fitted estimation technique for revenue collection levels (an indicated often used to assess the financial condition of public institution) by comparing three time series analysis techniques. The empirical analysis is based on data for all 3228 Romanian territorial-administrative units; real data for the 2008-2011 period as well as estimates developed from it are used in order to identify a time series technique that can be used by practitioners in order to estimate/forecast with high accuracy revenue collection levels. The remaining of this paper is organized as follows:

- Section 2 presents general considerations regarding financial estimations in the public sector, ranging from preliminary recommendations to how financial estimations should be prepared and limitations that might be encountered during estimation processes;
- Section 3 reviews estimation/forecasting typologies with a focus on time series analyses;
- Section 4 is dedicated to methodological and data related issues;
- Section 5 presents the empirical analysis (the statistical comparison of different time series analyses) and further discussions regarding the medium term accuracy of the estimation method identified as being best fitted for our data, and
- Section 6 concludes.

2. Financial estimations in the public sector

2.1. Preliminary recommendations regarding financial estimations

Howard (1989, pp. 4-9) proposes a series of ten advices that should help practitioners in making more accurate estimations as well as those that use these estimations (elected officials or beneficiaries) to better understand and use estimations accordingly. The first three principles refer to general economic forecast, the fourth one refers to revenue estimates, the following two refer to the data used for estimations, the seventh and eight principle refer to the process of monitoring revenues while the last two point out that in most cases revisions of the estimates made are needed.

The ten advices (good practices) can be adapted as follows (Howard, 1989, pp. 4-9):

- Beneficiaries should understand and participate directly in the development of an economic forecast that has broad acceptance;
- The estimating process should utilize the expertise of academic and business economists in developing the economic forecast;
- As a part of the revenue estimating process and to the extent possible, the legislative branch should be included in the development of the economic forecast;
- When presented with a revenue estimate, the beneficiary should understand the degree of uncertainty associated with it;
- Establishing an organizational structure that aids the developing of a single executive revenue estimate;
- Insure that the agency responsible for the revenue estimate has the data and personnel required to generate a good estimate;
- Require a monthly report on revenue collection and an annual report on the variance between revenue collection and revenue estimates;
- Monthly collections are a snapshot. Understand the difficulty of drawing conclusions based on short term revenue collections;
- The revenue estimate is based on a certain set of economic assumptions. Maintain the flexibility to respond to dramatic economic changes by revising the revenue estimate, and
- Consider the need to share revenue-related information with the public throughout the fiscal year and be consistent in the practice you choose.

Howard also draws attention that overestimating revenues can lead to budget cuts or tax hikes, while underestimating (which might be often preferred by policy makers) sets a negative shadow on the credibility and reliability of both estimates and public institutions (1989, p. 1). As such, the safest and desirable estimates are those that are the closest to empirical reality, which are both reliable and accurate.

Kyobe and Danninger (2005, p. 15) identify three elements of utmost importance in the revenue forecasting process:

- Organizational simplicity: the forecasting process should be cohesive and centralized, meaning that a limited number of public actors (institutions) should provide a single unitary forecast.
- Formality: a forecasting process should be 'formally defined, initiated, regularly reviewed, and documented'. Furthermore, a formal forecasting method should be employed.
- Transparency: outside actors should be included in the process, the macroeconomic assumptions used should be made public and the document should be detailed.

When observing how and if these elements are applied, Kyobe and Danninger (2005, p. 21) found that 'the level of formality, transparency, and organizational simplicity of a revenue forecasting process do not differ significantly across regions or by income per capita'. Furthermore, the authors' results show that formality and transparency are reduced when a country faces high levels of corruption, while past IMF involvement does not lead to more transparent revenue forecasting practices, but it increases the degree of formalization and institutionalization of those revenue forecasting systems (2005, p. 21).

2.2. Preparing financial estimations

Within the Romanian public administration system, The Macro-economic Analysis and Financial Policy General Directorate (MAFPGD), a core unit of the Ministry of Finance, is responsible for macro-fiscal planning, most importantly the preparation of revenue estimates; individual tax and non-tax revenues are projected from GDP-based estimates of major taxes with inputs from the National Agency for Fiscal Administration (The General Secretariat of the Government, 2010, p. 13). Revenue projections thus made, coupled with pre-established target deficits, establish the overall resource envelope available for budgetary expenditures (The General Secretariat of the Government, 2010, pp. 13-14).

Since realistic revenue forecasting stand at the base of credible budgeting, revenue forecasts should be 'prudent, technically sound and independent from political interference' (The General Secretariat of the Government, 2010, p. 16). As such, before effectively starting the estimation/forecast process, financial decision makers need to take into account a series of technical aspects in order to adapt the estimation technique to the purpose (or object) of the estimation, taking into account – at the same time – the resources they have at their disposal.

Thus, Wang (2006, p. 4) proposes a series of steps that should be followed in order to prepare an accurate and feasible estimation:

- Determining the object (or the overall goal/aim) of the estimation: decision makers need to establish what will be estimated (local taxes and revenues, expenditures or other indicators);
- Determining the time horizon: they need to decide for what time period should the estimation be made (a month, a year, 5 years, etc.), and
- Determining what estimation techniques are available and accessible: they must decide which estimation techniques can be utilized to analyze certain types of data for a certain period (as it was decided in the previous steeps) by the expert or experts tasked with doing the forecasting.

Starting from the aforementioned steps, the estimation method that best fits both the data available (or which can be collected) and the time horizon will be chosen, as long as the model can be used by those tasked with this process. Furthermore, the functional aim of the estimation must also be taken into account:

- If the estimation is made for internal use (to draft the local budget or to assess the financial condition of the organization), decision makers generally have a higher degree of freedom in choosing both the indicators and the model.
- If the estimation is made for external use (to borrow money, to establish a Public-Private Partnership, to obtain grants, etc.), decision makers have a lower degree of freedom in choosing the indicators and the method/model, because they must also take into account external constraints (for example to follow the methodology established by a lender – bank).

After establishing all these aspects (the aim and object of the estimation, the time horizon and the available resources), the indicators and the estimation method will be selected, the data will be collected and experts will then be able to make the estimation.

When analyzing the revenue estimating process adopted by the state of Michigan (the consensus process created by 1991 Public Act 72), Ross (2001, p.6) identifies three steps (or stages):

- In the first stage an analysis of previous differences between estimated and realized important state revenues (or other financial indicators) has to be made in order to assess the accuracy of previous estimates and adjust accordingly;
- In the second stage baseline revenue estimates are developed based on the future (estimated) economic growth, stagnation or decline, and
- In the third stage necessary adjustments should be determined and made to baseline revenues (due to tax changes, lawsuits, and one-time adjustments) in order to better predict the actual revenues.

2.3. General limitations during estimation processes

During the preparation stage as well as during the overall estimation process, financial decision makers and the experts involved in the estimation process need to take into account the following limitations:

- Only financial indicators that have a reduced degree of fluctuation can be accurately estimated. For example, we can estimate the revenues a local community will receive from property tax (since major changes are less likely to occur) but we cannot estimate the revenues a community will get from selling patrimonial goods (since these types of transactions do not take place regularly).
- The resources (human, informational, technical) available for the estimation process differ from case to case. Human resources (the expertise and experience of public servants), information (internal and external, official or especially collected for the estimation process) and the technical resources (software) available can influence the results of any estimation and differ from case to case. In these conditions, there is no method or estimation technique that can be universally applied.
- Time is another important resource in two distinct phases of the estimation process: (1) to collect data and information necessary for the estimation and (2) for the effective analysis of the data, to prepare the report and take a decision based on the estimations made.
- The degree of disaggregation/detail differs from estimation to estimation, thus influencing the entire process. Estimations can be done for different types of territorial-administrative units (commune, city, county, etc.) or at national or regional level; furthermore, the time periods for which estimations are made (from months to years) are seldom homogenous.
- Utilizing certain assumptions will affect the accuracy of the estimation. During the estimation process, certain knowledge or information regarding the legal framework, economic developments, demographic changes and so on are necessary; lacking this knowledge or due to incomplete information, those that make estimations need to use certain assumptions that can reduce the accuracy of estimations.
- Price fluctuations. Estimations or forecast will be less and less accurate as prices will fluctuate more.

Shkurti (1990, pp. 79-94) has a different take on revenue forecasting as he tries to identify the most common sources of errors that can occur in this process. As such, he identifies the following potential sources: (1) the

model and equation specification; (2) policy or other assumptions; (3) data revisions; (4) statistical error margins; (5) errors in estimating the timing of payments, and (6) errors in national economic forecasts.

As a result of such factors, revenue forecasts can yield inaccurate results that profoundly influence the creation and implementation of public policies. In the case of Wisconsin for example, between 2000 and 2003 'the average yearly error in state revenue growth estimation is almost 200 percent' and such errors have been connected with the deficits experienced (Wisconsin Policy Research Institute, 2004, p. 1).

3. Estimation/forecasting models

3.1. Estimation/forecasting typologies

Depending on the time horizon of the estimation as well as the functional purpose of the estimation, we can distinguish between (Schroeder, 1998, p. 99):

- Short term forecasting: made for a couple of months up to a year in order to draft the budget or to calculate short term financial indicators.
- Medium term forecasting: made for periods ranging between 2 and 5 years in order to obtain external funding or implement medium investment projects.
- Long term forecasting: for periods larger than 5 years for large scale infrastructural projects or planning (such as the 7 year EU programming period).

Another way to classify different estimation models is based on their complexity, cost and accuracy. As such, we can distinguish between (Lazăr, Inceu and Zai, 2005, pp. 527-530; Schroeder, 1998, pp. 102-110):

- Expert forecasting: based on the opinion/accuracy of a single expert or group of experts.
- Time series analysis: based on identifying patterns in multi-year data.
- Determinative forecasting: takes into account at least two factors (usually the estimation is a result between of multiplying a base and a rate).
- Econometric forecasting: complex statistical models that are based on economic theories (examples: location quotient, shift-share analysis, fiscal impact).

Although the methods presented above have different degrees of accuracy, when deciding upon what method to use, decision makers and analysts must take into account both advantages and disadvantages, not to mention the resources available and direct and indirect costs.

3.2. Time series analysis

From the aforementioned estimation methods, time series analyses seem to be the best balanced from the perspective of accuracy and resource usage (Wang, 2006, pp. 4-10). For example, Newaz (2008, pp. 55-65) uses Auto Regressive Integrated Moving Average (ARIMA), Exponential Smoothing (EXS), Naïve 1 and Naïve 2 models to forecast exchange rates for the Indian Rupee; data from September 1985 to December 2002 was used to build the models, while the remaining data points until June 2006 were used to check/measure the forecasting ability/reliability of the models. For this type of data, the ARIMA seemed to offer the best suited forecasts (Newaz, 2008, p. 63). As such, some of these methods (time series analyses) will be further detailed with direct references to public revenues.

- The Simple Moving Average (SMA): is the first and most simple time series technique. The estimation is made by dividing the total amount (obtained for a certain period of time) to the number of years/months (data points) included in the analysis. The SMA can be calculated as follows:

$$V_t = \left(V_{t-1} + V_{t-2} + V_{t-3} + V_{t-4}\right)/4 \qquad (1)$$

Where:

V(t)= amount for the period estimated

V(t-n)= amounts for the years/period on which the estimation was based.

As a limitation, it must be pointed out that this technique assumes that all revenues have equal importance/influence on the target estimate and the patterns that have developed in time are not taken into account. Furthermore, the fact that more recent revenues should hold a higher explanatory power for the estimation is not taken into account, as all previous values are calculated (imputed in the model) as equals.

- The Exponential Smoothing (EXS): acknowledges the fact that different years have a greater or smaller influence on the estimate and assumes that the period right before the estimate (the previous year) will influence the estimate more than other periods (years). Thus, the evolution in time of different indicators is taken into consideration, assuming that newer periods are more important; as such, although previous years have different explanatory power/significance, the most recent one is given more influence (in the mathematical formula) than the rest combined.

However, as in the previous case, there is no general rule regarding the significance of each year, the explanatory power of each time period being either derived from the data, or estimated by those that make the forecast. Exponential Smoothing can be calculated according to the following formula:

$$V_t = \left[V_{t-1} \times 4 + \left(V_{t-2} + V_{t-3} + V_{t-4}/3\right) \times 6\right]/10 \quad (2)$$

Where:

V(t)= amount for the period estimated

V(t-n)= amounts for the years on which the estimation was based

As a limitation of this model, it must be mentioned that even if the values increase or decrease in a constant pace over time, EXS can either underestimate or overestimate the forecast as it takes into account the average and not the patterns than can be observed in time.

- The Transformation Moving Average (TMA): Unlike previous time series techniques, the Transformation Moving Average (Wang, 2006) takes into account the patterns or trends that can be observed in time. Patterns or trends appear if indicators behave similarly (increase or decrease). Using the TMA, the incremental changes that occur in time are taken into account, thus this method will yield a higher accuracy than previous ones. The Transformation Moving Average can be applied in multiple stages:

In the first stage, the incremental change is observed by calculating the differences between each pair of years, starting with the most recent data.

In the second stage, the simple average of these differences will be computed.

In the third stage, the average obtained in the second phase is added to the last year for which data is available.

Mathematically, the TMA can be represented as follows:

$$a + b : \left[\left(V_{t-1} - V_{t-2}\right) + \left(V_{t-2} - V_{t-3}\right) + \left(V_{t-3} - V_{t-4}\right)\right]/3 \quad (3)$$

$$c: V(t) = V(t\text{-}1) + \textit{the simple average of the differences (computed at a+b)} \quad (4)$$

Where:

V(t)= amount for the period estimated

V(t-n)= amounts for the years on which the estimation was based

4. Methodology and data

4.1. Data and variables

The data used for this study was obtained from The Direction for Fiscal Policies and Local Budgets (DFPLB, 2013) and it is publicly available for researchers interested in the level of revenue collection in Romania (this can be considered one of the most successful instances of transparency applied in the Romanian public sector). However, in order analyze the data in SPSS, some modifications were required. First of all, the data was originally obtained in Excel format and presented some features that were incompatible with SPSS. The data was thus coded and transported to SPSS, eliminating elements that were either incompatible with SPSS or did not present any interest for this research (such as the Siruta Code).

The final SPSS database included the names and types of territorial-administrative units, the regions of development and the level of revenue collection (in percentages: what was collected/what was predicted at the beginning of the budgetary year) for 2008, 2009, 2010 and 2011. The levels of revenue collection will be used as dependent variables, while regions of development and the type of territorial-administrative units will be used as independent (explanatory) variables.

Revenue collection levels for 2008-2011, the dependent variable of this research, are ratio data, calculated by the following formula: revenues effectively collected (at the end of the budgetary year)/revenues predicted or proposed (at the beginning of the budgetary year).

Romanian territorial-administrative units were used as independent variables, are nominal data and were recorded using the following values: 11 for county (județ), 12 for municipalities (municipiu), 13 for city (oraș), 14 for commune (comuna), and 16 for sectors (sector).

The regions of development used in the analysis as independent variables are nominal data. They are as follows:

- North East (includes all territorial-administrative units from the following counties: Iași, Botoșani, Neamț, Suceava, Bacău and Vaslui);
- South East (includes all territorial-administrative units from the following counties: Vrancea, Galați, Brăila, Tulcea, Buzău and Constanța);
- South (includes all territotial-administrative units from the following counties: Prahova, Dâmbovița, Argeș, Ialomița, Călărași, Giurgiu and Teleorman);
- South West (includes all territotial-administrative units from the following counties: Mehedinți, Gorj, Vâlcea, Olt and Dolj);
- West (includes all territorial-administrative units from the following counties: Arad, Caraș-Severin, Hunedoara and Timiș);
- North West (includes all territorial-administrative units from the following counties: Bihor, Bistrița-Năsăud, Cluj, Maramureș, Satu-Mare and Sălaj);
- Center (includes all territorial-administrative units from the following counties: Alba, Sibiu, Mureș, Harghita, Covasna and Brașov), and
- Bucharest (includes all territorial-administrative units from the sectors of Bucharest and the county of Ilfov).

4.2. Finding the best fitted estimation method

In order to assess which estimation method from those presented is best fitted for the data available, a selection process was conducted. The criteria according to which the selection was made are the following:

- Simplicity: considering that not all Romanian local authorities have the human resource (expertise) and the technical means (IT software) to engage in complicated estimation techniques, the assumption is that

simpler techniques have a higher probability to be implemented (used). Secondly, simpler techniques should be chosen as they present fewer data requirements (thus reducing the costs of estimations).

- Replicability/transferability/generalization: the estimation technique should be similar for all local public authorities and should have a high degree of transferability. The accuracy of results obtained by applying a technique in/by one local public institution should be similar if the same technique is applied elsewhere.
- Accuracy/reliability: the technique should have a higher degree of accuracy and reliability as unreliable and inaccurate estimates can cause more harm than good, if they are used in the budgetary process. For example, an overestimation of revenues will lead to fiscal deficits, while an underestimation will lead to inadequate public policies (as policy makers believe that they have fewer resources to tackle certain issues).

Based on the first criterion, the most complicated (advanced) estimation technique (namely econometric forecasting) has to be eliminated, as local authorities might not have the data, human resources or technological capabilities to engage in such endeavors.

Based on the second criterion, expert forecasting has to be eliminated as this technique cannot be generalized and relies heavily on the continuous existence of the expert; if the expert departs the institution, there will be no one left in its place to continue the estimation process (at least not in the way he was doing it).

Based on the third criterion, determinative forecasting has to be eliminated, as although the rate (how much do taxpayers have to pay for a certain good or property they own or for a certain service) might be generally known, the base (goods, property or activity for which taxes are paid) is generally problematic (considering that an important part of Romanian economic activity is conducted in the underground/shadow economy).

As such, although this paper does not argue that time series analyses are the best estimation techniques existent, they are the only ones that do not infringe on any of the aforementioned principles. As such, the SMA, EXS and TMA were used to create estimates for 2011, based on 2008, 2009 and 2010 data. The estimates were made using Microsoft Excel 2007 Analysis Toolkit. The estimates were named using the abbreviation of the time series technique used to calculate them and the year for which they were calculated (SMA2011, EXS2011 and TMA2011)

Afterwards, the estimates made with SMA, EXS and TMA were compared with the actual 2011 data; since the estimates and the actual data refer to the same territorial-administrative units, the best fitted method will be that which provides the estimates with the smaller differences from the actual 2011 data. The comparison was made with SPSS using the Paired sample T Test.

5. Empirical analysis: estimation/forecasting methods and their reliability

5.1. The best fitted time series analysis

The first step in order to observe which model is best fitted for the data available was to compare the overall mean obtained using the three time series analyses with the actual 2011 data (Table 1).

Table 1 shows that the smaller mean difference between the actual and estimated data is obtained using the TMA (Actual2011-TMA2011=0.06), followed by the SMA (Actual 2011-SMA2011=4.34) and EXS (Actual2011-EXS2011=15.5.). This indicates that TMA would be better fitted for the data available, but the evidence is far from being conclusive.

Table 1. Descriptive statistics - estimates versus real data for 2011

Comparisons		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Actual 2011	84.63	3228	12.38	.21806
	SMA 2011	80.29	3228	11.36	.20011
Pair 2	Actual 2011	84.63	3228	12.38	.21806
	EXS 2011	69.13	3228	9.38	.16520
Pair 3	Actual 2011	84.63	3228	12,38	,21806
	TMA 2011	84,57	3228	17,73	,31223

The correlations table (Table 2) does not provide further support to confirm or infirm the aforementioned observation as all three estimates is similarly and statistically significant correlated with the actual data. This can be easily explained by the fact that the data is intrinsically connected, as revenue collection levels tend (generally speaking) to present low level of fluctuation in normal conditions.

Table 2. Correlations - estimates versus real data for 2011

Paired Samples Correlations				
Comparisons		N	Correlation	Sig.
Pair 1	Revenue collection 2011 & SMA 2011	3228	.446	.000
Pair 2	Revenue collection 2011 & EXS 2011	3228	.487	.000
Pair 3	Revenue collection 2011 & TMA 2011	3228	.429	.000

Table 3. Paired Sample T Test - estimates versus real data for 2011

Comparison between	Paired Differences					Df.	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
Actual 2011 – SMA 2011	4.33	12.52	.22053	3.90	4.77	19.673	227.000
Actual 2011 - EXS 2011	15.50	11.32	.19937	15.11	15.89	77.763	227.000
Actual 2011 – TMA 2011	.05	16.72	.29433	-.51	.63	.19	3227.845

Table 3 on the other hand offers conclusive evidence that the TMA is best fitted for the data available, as the differences between SMA 2011/EXS 2011 and the actual data for 2011 are statistically significant (as Sig. = .000), thus these two techniques do not fit the data.

The difference between the TMA estimates and the actual data are not statistically significant (Sig. = .845), meaning that there is no difference between the actual data and the estimates (Table 3). As such, the TMA

seems to be the time series techniques best fitted for the data available and it will be used to further develop medium term estimates as it is the only one which yields forecasts that are not statistically different from the actual data.

5.2. Testing the medium term accuracy of the estimation method

In the following analysis, the levels of revenue collection will be analyzed according to the type of community and region of development, both for the actual 2008-2011 data and for a predicted/forecasted period (2012-2015), in order to assess the accuracy of the TMA on medium term. Table 4 shows that, when analyzing the level of revenue collection according to the type of community, the trend or pattern seems to be a positive one, both for the real data and the estimated period:

- Between 2008 and 2011 (real data) there was an overall increase of 5.26 percentage points;
- Between 2011 and 2015 the model estimates that overall revenue collection will increase by 6.97 percentage points.
- In the entire period, each and every type of community shows a positive trend regarding revenue collection, meaning that they attained higher and higher levels of revenue collection.

Table 4. Revenue collection by type of community (2008-2015)

Type	N	2008 Mean	2009 Mean	2010 Mean	2011 Mean	2012 Mean	2013 Mean	2014 Mean	2015 Mean
County	41	79.15	78.37	82.29	84.10	85.74	87.39	89.49	91.21
Municipality	103	81.87	82.37	84.05	84.06	84.80	85.53	85.65	86.79
City	217	79.69	79.78	81.25	82.33	83.21	84.09	84.41	85.19
Commune	2861	79.25	78.43	82.91	84.82	86.68	88.53	90.61	92.51
Sector	6	85.39	87.98	91.92	92.53	94.90	97.28	118.64	124.19
Total	3228	79.37	78.67	82.84	84.63	86.39	88.14	90.07	91.86

However, further discussions are required before continuing the analysis. In the case of sectors, the model predicts for 2015 a revenue collection level of 124.19%, which seems to be more or less an exaggeration when taking into account the scale of the six budgets represented here. A possible explanation for this unlikely prediction could be that the model tends to exaggerate the patterns and trends it identifies in the data; as such, it might underestimate previous positive outliers and overestimate negative ones. In order to test the aforementioned observation, Table 5 presents an extended version of the main central tendency statistics that can be computed with SPSS for this type of data.

The data regarding TMA 2012 (the first year of forecasting) is – generally speaking – in accordance with the previous four years (referring to actual data). However, starting with the 2nd year of estimation (namely TMA 2013), it can be easily observed that the model shows some limitations, as it assumes that the lowest level of revenue collection for communes will be negative (-13,44). Since this is ratio data (a percentage), it would be impossible to achieve revenue collection levels below 0, thus at least this particular individual estimate is highly inaccurate.

Table 5. Revenue collection by type of community - extended statistics (2012-2015)

						95% Confidence Interval for Mean			
		N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
TMA 2012	County	41	85.7488	5.94754	.92885	83.8715	87.6260	74.84	99.25
	Municipality	103	84.8009	14.41238	1.42009	81.9842	87.6176	27.71	108.91
	City	217	83.2139	16.70456	1.13398	80.9789	85.4490	28.33	130.03
	Commune	2861	86.6803	16.20695	.30300	86.0862	87.2744	7.64	147.26
	Sector	6	94.9089	11.01308	4.49607	83.3514	106.4667	73.13	102.93
	Total	3228	86.3908	16.11323	.28361	85.8347	86.9469	7.64	147.26
TMA 2013	County	41	87.3970	7.54987	1.17909	85.0139	89.7800	72.92	106.50
	Municipality	103	85.5327	18.62867	1.83554	81.8919	89.1735	10.13	120.67
	City	217	84.0928	21.11866	1.43363	81.2671	86.9185	15.67	150.09
	Commune	2861	88.5373	20.96216	.39190	87.7689	89.3058	-13.44	159.72
	Sector	6	97.2878	13.81051	5.63812	82.7945	111.7810	69.96	106.73
	Total	3228	88.1445	20.80586	.36620	87.4265	88.8625	-13.44	159.72
TMA 2014	County	41	89.4954	10.52444	1.64364	86.1735	92.8173	67.13	113.14
	Municipality	103	85.6504	26.40689	2.60195	80.4894	90.8113	-27.39	139.23
	City	217	84.4129	29.23272	1.98445	80.5015	88.3242	-10.40	181.64
	Commune	2861	90.6162	29.20247	.54596	89.5457	91.6867	-49.84	187.75
	Sector	6	118.6484	18.93332	7.72950	98.7791	138.5178	81.43	131.67
	Total	3228	90.0786	29.00915	.51059	89.0775	91.0797	-49.84	187.75
TMA 2015	County	41	89.4954	10.52444	1.64364	86.1735	92.8173	67.13	113.14
	Municipality	103	85.6504	26.40689	2.60195	80.4894	90.8113	-27.39	139.23
	City	217	84.4129	29.23272	1.98445	80.5015	88.3242	-10.40	181.64
	Commune	2861	90.6163	29.20249	.54596	89.5458	91.6868	-49.84	187.75
	Sector	6	118.6484	18.93332	7.72950	98.7791	138.5178	81.43	131.67
	Total	3228	90.0787	29.00917	.51059	89.0776	91.0798	-49.84	187.75

The estimates for 2014 and 2015 present more negative outliers (minimum values) below zero, providing further evidence that, in the case of outliers, the model is fairly limited when faced with medium and long term forecasting. However, although the model presents some limitations in the case of outliers, especially in the context of medium and long term estimations, it should be noted that the overall forecasts (averages) remain fairly accurate (or at least believable).

Furthermore, when analyzing revenue collection levels by type of community, we must also take into account that the categories/groups do not have an equal number of cases. For example, there are only six sectors and more of them can all act as outliers; without more data points to counter these outliers (as in the case of communes, cities, municipalities, etc.) the overall estimates for this category might be unrealistic.

Table 6 presents the data (real and estimates) in a more balanced way, according to regions of development. According to this grouping, the smaller number of cases is in the Bucharest region of development, but now beside the 6 sectors the county of Ilfov is also included in the same group.

Table 6. Revenue collection by region of development (2008-2015)

Region	N	2008	2009	2010	2011	2012	2013	2014	2015
N-E	558	74.43	75.42	81.06	82.25	84.85	87.46	89.98	92.57
S-E	396	81.57	78.68	80.52	81.89	82.00	82.10	82.90	83.12
S	574	76.61	73.85	80.94	83.43	85.70	87.97	90.14	92.39
S-W	453	76.90	75.32	81.42	84.51	87.05	89.59	92.29	94.86
W	327	82.94	81.69	83.91	87.55	89.09	90.63	92.58	94.19
N-W	452	85.34	85.97	89.57	90.61	92.37	94.13	96.13	97.93
C	420	80.02	81.90	82.82	83.49	84.65	85.80	87.03	88.20
B	48	88.74	87.80	88.35	84.27	82.77	81.28	81.20	79.94
Total	3228	79.37	78.67	82.84	84.63	86.39	88.14	90.07	91.86

In most cases, the level of revenue collection presents a positive trend, both for the actual 2008-2011 data and for the 2012-2015 estimates. There is however an exception, namely Bucharest: if in the previous grouping the 6 sectors (most of which were outliers) were overestimated, in this case they are counterbalanced by others territorial-administrative units from Ilfov county, thus resulting in a more realistic forecasting of this group.

A better image of the level of revenue collection depending on the type of community is offered by the Turkey box plots presented bellow (prepared in SPSS, using the Explore command).

In 2012 (the first year forecasted using the TMA) there are few observable differences compared to previous periods (Figure 1). The North-West region and the South still present positive outliers, while all regions present negative ones. However, the negative ones are still within normal limits (i.e. none under 0).

The situation changes once we analyze the other estimates made by the TMA (Figures 2 to 4), namely the values for 2013 (the second year for which forecasts were made), 2014 (the third year for which forecasts were made) and 2015 (the fourth year for which forecasts were made). As such, starting with 2013:

- The data presents increasingly more positive and negative outliers and is less grouped together that in previous cases, suggesting a higher level of heterogeneity;
- Negative outliers are below 0, which is not possible or realistic when we take into account the nature of the data and what it represent (as explained earlier).
- These two negative trends/patterns become more pregnant as the estimates are more distant from the actual data. In other words, as we increased the period for which we want to make estimates, the reliability and accuracy of the forecasting model decreases.

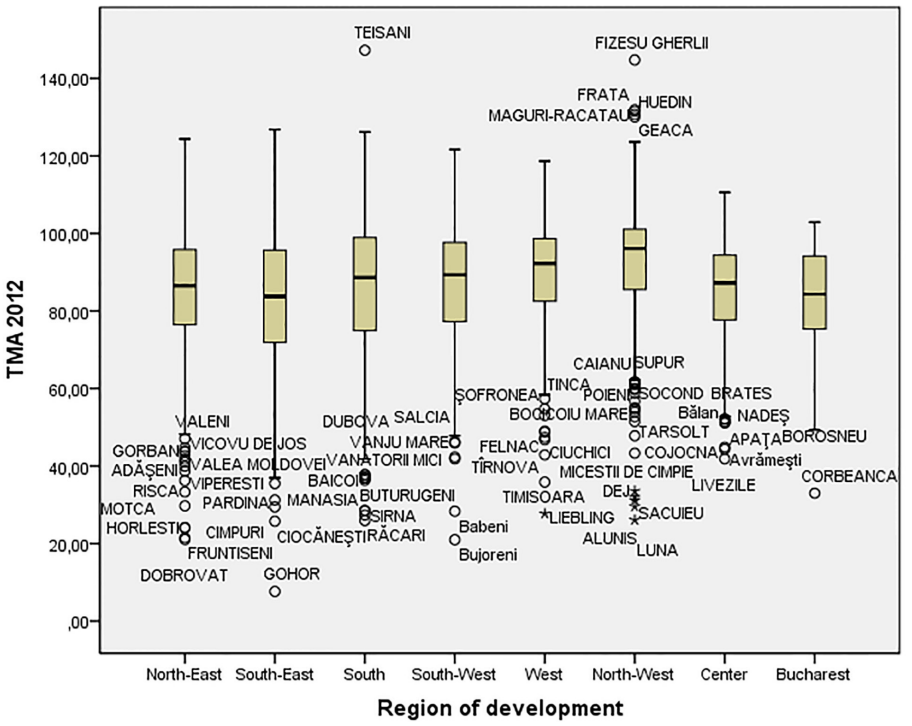

Fig. 1. Revenue collection by region of development in 2012 (TMA)

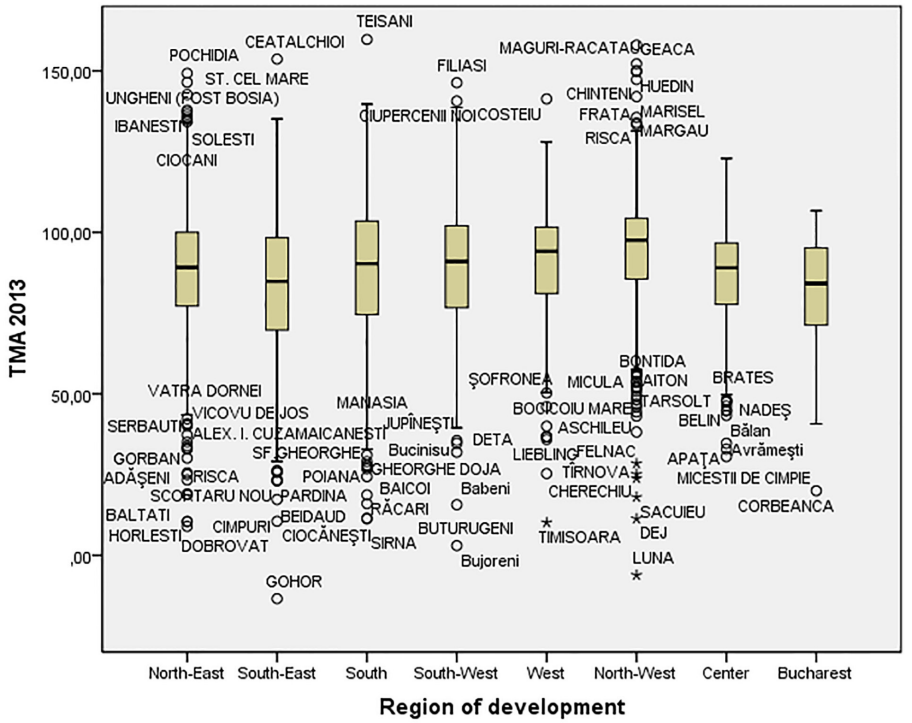

Fig. 2. Revenue collection by region of development in 2013 (TMA)

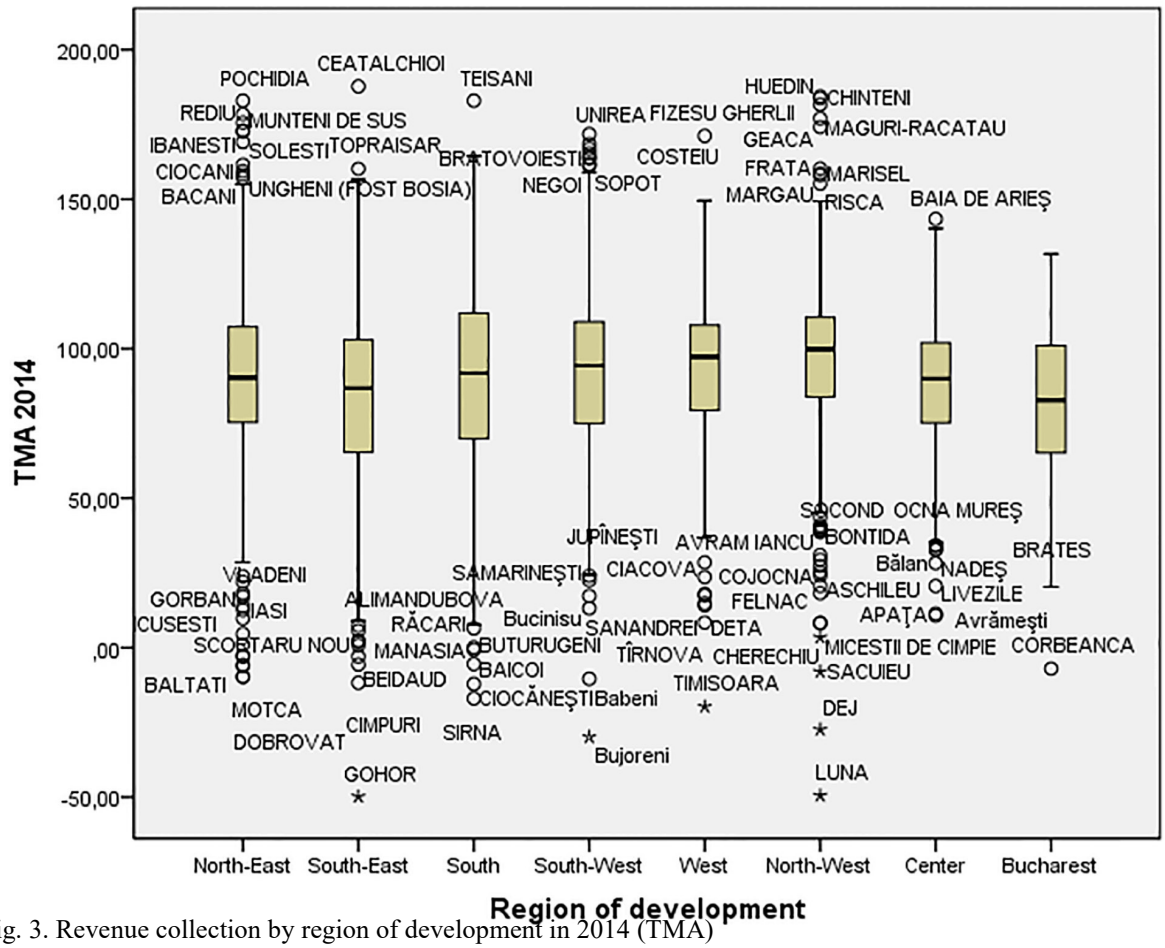

Fig. 3. Revenue collection by region of development in 2014 (TMA)

Overall, compared with the SMA and EXS, the TMA is the best fitted time series forecasting technique for this type of data as it will take into account trends and offer feasible estimates. However, the TMA tends to overestimate positive outliers and underestimate negative outliers, thus it would be advisable to use it for short/medium term forecasts (1-2 years).

Furthermore, the overall descriptive analysis of the data (as presented in Table 4 and 6) offers evidence that revenue collection levels will improve in time. Few exceptions still remain as some local communities will continue the downward trend, but at national level, there are reduced chances for these negative developments to remain a significant issue.

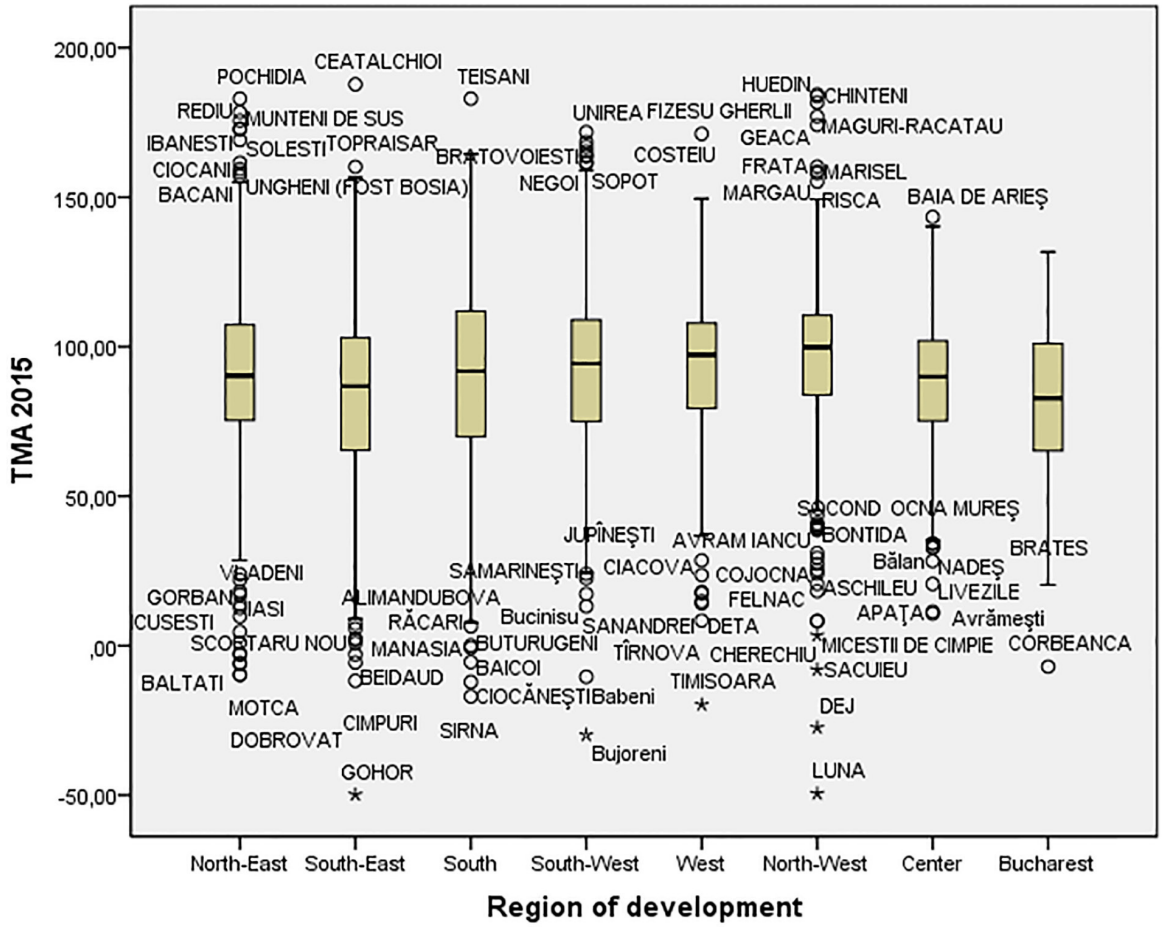

Fig. 4. Revenue collection by region of development in 2015 (TMA)

6. Conclusions

From the three forecasting methods tested (SMA, EXS and TMA), the TMA seems to be the time series techniques best fitted to the data available as it will take into account trends and offer feasible estimates. However, the TMA tends to underestimate positive outliers and overestimate negative outliers, thus it would be advisable to use it only for short/medium term forecasts (1-2 years). Nonetheless, if given a large enough samples, the TMA will yield accurate general estimates, but it may prove itself unreliable or inaccurate in individual cases, especially if the data presented high fluctuation in the past.

Furthermore, the TMA is a very simple estimation method which can be done both using PC software or by pen and paper. TMA is based on very few assumptions (that the data does not fluctuate greatly), takes into account patterns/trends and offers fairly accurate result. As such, it can be used even by public servants from smaller communities that do not have access to more complex methods, advanced informational equipments or who might feel insecure in applying complicated forecasting techniques (that require more data and calculations) to create a scenario for the future.

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