LOCAL PUBLIC SERVICES´ DEMAND SIDE FACTORS´ STRUCTURE IN DIFFERENT TYPES OF ESTONIAN MUNICIPALITIES

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Abstract

The local public services are mostly investigated from supply side: the dependency of their scope and quality from local governments' revenues, also the economic effectiveness of their production. This paper deals with demand side factors of impure local public services in different types of Estonian municipalities to characterise the regional aspects of public sector development. Population size and structure, as well as income levels and employment structure of inhabitants of the municipalities are considered as demand side factors of impure local public services in this study. The levels and structure of impure local public services are characterised through ratios of different types of budget expenditure to number of inhabitants or service users, but also through shares of different expenditure types in Estonian municipalities.

The goal of this paper is to assess comparatively the influence of population size and structure, as well as income level and employment structure of working inhabitants on the average ratios of different types of budget expenditure per inhabitant or user, but also on shares of different types of budget expenditure in Estonian municipalities of different types. To achieve the goal we engage in the following research tasks:

- Analyse the relationships between the local government expenditures on impure public services and their main demand side factors based on research literature;
- Assess quantitatively the impact of municipality population characteristics on the local government budget expenditure levels and structure in different types of Estonian municipalities;
- Comparatively analyse differences in impact direction, intensity and significance of demand side factors between different Estonian municipality types and changes in them.

The empirical analysis is carried out with the assumption that the output of political processes reflects the average opinion of inhabitants of municipalities about level and structure of expenditures on impure local public services. In other words, we assume that the expenditure level and structure of the local government budget is in accordance with the preferences of the median voter, or, the supply of impure local public services equals demand of the municipality population.

The differences in the structure of municipal government spending should therefore result from differences in the levels, structure and dynamics of demand-setting factors. The significance, direction and intensity of the potential factors can then be identified using relationship analysis methodology (correlation analysis, principal component analysis, regression analysis). The empirical part of this study is built upon this approach. Data used in the empirical analysis is from the Statistical Office of Estonia and Estonian Tax and Customs Board.

The results of the analysis show that components characterizing the structure of impure local public services' demand side factors can be found and that the supply of impure local public services can be modelled with those components, but expect for education expenditures, only a small share of variation of local public service expenditure levels and structure can be explained using simple linear regression models. The usefulness of more complex regression models requires separate investigation.

Introduction

The local governments have to assure the supply of pure public services, like the presence of state power in towns and parishes, as well as the supply of impure (mixed, quasi) public goods and services that can be individualized (they satisfy the conditions of excludability and rivalry) and that directly increase the welfare of the population – education, leisure and culture services, economic services and public utilities. In the theory the public provision of essentially private goods is explained by voter demand for such goods and services (de

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Groot, Pommer 1987: 257). To improve the effectiveness of public service provision, the local governments have to adapt the supply of those goods and services as flexibly as possible to demand and its changes among municipality inhabitants.

The determination of demand factors for impure public goods and services is a complicated task for researchers and politicians as well. The absence of a market mechanism (due zero or subsidized price of consumption) deprives the demand of impure public goods and services of direct control of payment ability and willingness of consumers. At the same time the political decision-making process for shaping the budget structure of local governments determines the provision of impure public goods and services under complicated reciprocal impact of politicians, bureaucrats and lobby-groups from outside of local government institutions. As a result the preferences of the municipality inhabitants have been taken into account indirectly. For finding out the shortcomings and improving possibilities of the political decision making processes it is important to assess the demand side factors of impure local public goods and services.

Hans de Groot (1989: 123) has given the overview of the literature about approaches for assessing the demand of local public services and their critics. At first, economists have tried to explain budget structure of local governments by stylized theories like the median-voter theory, but this approach does not take into account the influence of bureaucrats and lobby-groups. Secondly, the hedonic approach tries to infer the public goods and services demand from demand of complementary market goods, but this approach is practically not applicable. Thirdly, a popular method is the survey method of citizens preferences, based on simply asking the inhabitants opinion about the level of municipal government expenditure on public services: would you prefer more or less spending on one or another kind of public service. Surveys have been used for direct measurement of the individual willingness to pay for particular public goods. Lastly, a more sophisticated approach is a budget game, in which expenditure levels can be varied simultaneously with different constraints.

In this article the empirical analysis is carried out with the assumption that the output of political processes reflects the average preference of municipality inhabitants (the median voter approach). Unlike traditional approaches, this study does not examine the opinions of individual inhabitants (usually derived from public surveys) on the need to change the expenditure structure of the municipal government budget along with parameters characterizing the individual. Instead, the object of this study is the expenditure structure of each individual local government budget on the one side and the parameters that characterize it population on the other side. It is assumed, the differences in the structure of municipal government spending should result from differences in demand-setting factors.

Differences between the municipalities in demand for impure public goods and services are primarily caused by differences in population size and structure. The significance of demographic factors for demand for impure local public services is generally recognised. The population structure and changes in it affect the optimal size of local public service delivery areas. Deciding upon the optimal area size for different local public services is a difficult challenge for local governments that requires innovative approaches. Designing optimal service delivery areas, in turn, is made difficult by the fact that it is often necessary to organize cooperation between multiple municipal governments. In Estonia, however, cooperation between local governments is at a very modest level. The co-operation of municipal governments in USA in forming special districts for provision of health care services has developed step by step during the last fifty years (Bates et al. 2011).

Insufficient attention has been given to other factors affecting local public service demand. For example, it can be assumed that the income level and structure of the municipality inhabitants has an effect on the demand for local public services, as do changes occurring within these factors. In municipalities with high income level of inhabitants, demand for social services is low and more attention and resources can be allocated to leisure services. Substantial effects on demand for impure local public services can also be expected from the employment structure of the population. For example, workers with low qualifications usually have a lower demand for culture services than highly qualified white-collar labour force. Thus, the employment structure in terms of type of economic activity has to be taken into account in public policy-making at the local level. The specific demand for impure local public services (e.g. social services) can also be caused by unemployment (the rate, duration) of the municipality inhabitants. For these reasons, the remaining factors affecting the demand for local public services mentioned above (besides population age structure) are also included in the analysis.

Factors shaping demand of impure local public goods and services in Estonian municipalities have undergone large and controversial changes during the last decades. Municipalities in remote areas are generally losing active working age population. There, due to the departure of mobile young people, the proportion of older and inactive people is increasing. However, in the economic centres the demographic processes are working in the

opposite direction. The income structure of inhabitants in terms of type of economic activity is very different among municipalities and the economic boom and the crisis both led to significant changes in this respect, potentially resulting in a significant impact on demand for local public services. These changes must be recognised in order to improve the cost efficiency of local public services provision, including for example, designing optimal service delivery areas.

The goal of this paper is to assess comparatively the influence of population size and structure, as well as income level and employment structure of working inhabitants on the average ratios of different types of budget expenditure per inhabitant or user, but also on shares of different types of budget expenditure in Estonian municipalities of different types. To achieve the goal we engage in the following research tasks:

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The article consists of three parts. The first part deals with the relationships between the demand for impure local public services and the main parameters that characterize the population of a municipality, based on existing theoretical and empirical studies. In the second part an empirical analysis is carried out to assess quantitatively the influence of municipalities' population characteristics on the structure of local governments' budget expenditure shares (by service type) and their ratios per inhabitant or user. The third part deals with comparative analysis of direction, intensity and significance of statistical relationship between expenditure structure of local governments and municipalities inhabitants' demographic, employment and income characteristics in two types of Estonian municipalities – towns and pure rural parishes.

1. Demand Side Factors of Impure Local Public Services

Basics of the formation of demand for impure local public services are difficult to understand. An individual usually does not have a complete understanding of the tax price of public services (the expenditures of the taxpayer) and the budget constraints of the public sector, making his or her opinion of the amount and quality of public services needed in excess of the economic capacity of the public sector. Both politicians and voters lack the information required to assess the quantity and quality of public services needed, so preferences are formed and decisions made about the structure of the public sector budget and expenditure on public services (Becker *et al.* 1992: 54). Because the willingness of society to pay for impure public services is very difficult or impossible to determine due to the lack of adequate empirical methods (Becker *et al.* 1992: 24-84), the demand for a particular public service and the decision to increase, maintain or reduce the share of expenditures on a certain public service in the budget is evaluated based on surveys (Becker *et al.* 1992: 102).

The focus of mainstream scientific research analysing the formation of demand for public services is the competition among different population groups over public sector budget allocations in political processes, and the political influence of different population groups in public sector budget decisions. Particular attention has been given to the hypothesis of possible competition between the young and the elderly in shaping the expenditure structure in municipal budgets. The results of research are controversial. Many authors (Borge, Rattsø 2008; Cattaneo, Wolter 2007; Strömberg 2006; Grob, Wolter 2005; Poterba 1997 and others) have empirically identified a relationship whereby an increase in the proportion of elderly people in society leads to a decrease in child care and education spending per child and pupil. At the same time there are authors (Brunner, Balsdon 2004; Gradstein, Kaganovich 2004; Ladd, Murray 2001; South 1991), whose studies argue against the existence of such a relationship and show positive attitudes among the elderly towards increasing expenditures on education. Of course, the attitude of different groups of people towards increasing or decreasing expenditures on certain public services and the actual effect of those attitudes on political decisions are different things.

The situation is different in different countries. Scott J. South (1991), in his study, shows that children and the elderly in the US are not direct competitors for local public sector expenditures, because elderly welfare programs are funded by the federal government and the welfare of children is the responsibility of the states. Similar issues should be taken into consideration when analysing local public services in Estonia because expenditures on certain public services (e.g. education) do not depend on the economic opportunities and political decisions of municipalities alone.

The impact of the income level of population on financing impure local public services is less researched. Fernandez and Rogerson (2001) find on the base of a panel data set for the 48 states of continental USA for 1950–1990 that expenditures per student in public primary and secondary schools have a strong positive correlation with the income level of the residents and a moderate negative correlation with the number of students. The proportion of elderly, however, did not have a statistically significant relationship with expenditures per student.

Becker *et al.* (1991: 28) mention as factors affecting the demand for local public services, in addition to age, income levels and the tax burden and people's assessment of the rationality and efficiency of the use of money in the public sector. It should also be noted that the availability of public services intended for families and children often depends to some degree upon the income level of families (Becker *et al.* 1991: 90), and this must especially be considered when determining the share of the total costs the family has to pay itself for a service. Studied is the distribution of public expenditure on subsidized (impure) public goods and services over income categories (Van´t Eind *et al*. 1986).

Kalwij and Salverda (2007) show how a change in a family's demographic structure and employment changes the spending patterns of the family. Similarly, changes in the demand for local public services must be taken into account as changes in the family occur. A decrease in the number of children in families reduces the demand for kindergarten and school places. An increase in the proportion of single parent families will increase the demand for kindergarten places, so the lone money earner in the family could go to work. Children leaving the parental home will in the long run lead to increased demand for elderly care. However, increases in family income levels increase the livelihood of families and reduce the demand for social services.

In summary, primarily population age structure has been analysed as a factor influencing demand for local public services. Other factors have not found significant attention. The reason for this probably lies in the fact that there is no systematically gathered municipal data for the other factors. This study used data from the Estonian Tax and Customs Board, which allows us to identify the employment structure and income level of municipalities' inhabitants by type of economic activity. By using this data we can extend the list of factors influencing demand for local public services and test the hypothesis that the municipal government budget expenditure structure also depends on the employment structure and income level of inhabitants.

2. An Empirical Analysis of the Impact of Demand Side Factors on the Provision of Impure Local Public Services

2.1 Methodology and Data

According to the purpose of this article we focus on the question of which factors determine demand for impure local public services, in other words, affect the opinion of individuals about changing the level and structure of local government spending, and how these factors differ among municipality types. The empirical analysis is carried out with the assumption that the output of political processes (i.e. forming local government budget decisions) reflects the average opinion of individuals (the median voter). In other words, we assume that the expenditure structure of the municipal government budget is in accordance with the opinion of the median voter; or, the supply of local public services by local government equals demand of municipality inhabitants. Unlike traditional approaches, this study does not examine the opinions of individual inhabitants (usually derived from public surveys) on the need to change the expenditure structure of the municipal government budget along with parameters characterizing the individual (age, income, etc.). Instead, the object of this study is the expenditure structure of each individual local government with the parameters that characterize the population of the municipality (the proportion of different age groups in the population, employment structure by type of economic activity, etc.). In some municipalities and for some type of services, political processes lead to an overestimation of the opinion of the median voter about the optimal share of expenditure on the viewed public service in local government budget and in others to an underestimation, but the average estimation of a large pool of municipalities should approach the average opinion of the median voter on the optimal expenditure structure of the municipal government budget. The differences in the structure of municipal governments spending should therefore result from differences in the levels, structure and dynamics of demand-setting factors in the municipalities. The significance, direction and intensity of the potential factors influence can then be identified using relationship analysis methodology (correlation analysis, principal component analysis, regression analysis). The empirical part of this study is built upon this approach.

The population age structure and local public service levels and structure of Estonian municipalities will be analysed based on data from Statistics Department of Estonia (ESA), and the job related income (salary) levels

and employment structure (by economic activity type) of working inhabitants will be analysed based on Estonian Tax and Customs Board (EMTA) data.

The empirical analysis is carried out for 2010 (shortly after economic crisis) for two municipality groups, for municipalities in a town region in Estonia (97 municipalities) and for pure rural municipalities[4] in Estonia (116 municipalities). Municipalities with less than 500 inhabitants where left out of the analysis because the expenditure structure of their government budgets might be significantly affected by special state programs, and therefore, differ from other municipalities with more autonomous local government budgets. The analysis also did not include municipalities for which some data was not available.

The variables used in the analysis for describing the municipalities can be divided into three groups:

1. Variables describing the supply of impure local public services: the share of expenditures on different public services (education, leisure, culture, public utilities, economic services, social assistance) in the municipal government budget; local public service expenditures per inhabitant or per certain group member (e.g. education expenditures per child under age 19).
2. Demographic characteristics of municipality inhabitants that are expected to shape the demand for impure local public services: population size, population age structure, dependency ratio and demographic labour pressure index, percentage of unemployed in the population.
3. Characteristics of income levels and employment structure of the municipalities working inhabitants: job related income (salary) level per inhabitant and per tax payer, job related income (salary) structure by economic activity type (NACE classification), employment structure by economic activity type (NACE classification).

The content and names of the supply variables used in the analysis are presented in Appendix 1 and the content and names of the demand variables in Appendix 2.

Our hypothesis is that the development of the structure and level of local governments expenditures on impure local public services is significantly affected by population structure, income levels and employment structure in the municipality. To test the hypothesis, at first a correlation analysis between parameters of local governments expenditures characterizing the supply of impure local public services and variables characterizing demand side factors for these services was carried out. Secondly, principal component analysis of variables characterising demand side factors of impure public services was conducted. Finally, multiple regression models of local governments' expenditure structure parameters as dependent variables were constructed on the base of principal components of variables system characterizing demand side factors of impure local services. The statistical data analysis software STATA was used to carry out the analysis.

2.2 Correlation analysis

The correlation analysis revealed a lot of statistically significant correlations between variables characterizing local governments' expenditures on impure public services and variables describing municipalities' population age structure, income and employment levels, but also income and employment structure by economic activity type (NACE classification). It should be noted that in 2010 the municipalities were not yet out of the crisis: the municipal governments budget revenue base that the Estonian central government restricted during the crisis had not recovered, price increases were raising municipal governments' costs, their ability to determine the structure of the budget was still very limited (a large proportion of expenditures has be directed to financing mandatory tasks). Therefore, it can be assumed that the relationships between municipal government budget expenditure levels and structure and political interest groups are in 2010 weaker compared to stable socio-economic conditions. At the same time, stabilization of the economic environment should change and strengthen the relationships between local public service demand side factors and municipal government budget expenditures on impure public services in the future.

The results of correlation analysis confirmed the hypothesis of the influence of local public service demand side factors on supply of impure local public services (measured through municipal government budget expenditure structure characteristics). All municipal government budget expenditure structure characteristics have statistically significant relationships with variables expected to describe the local public service demand side factors. On the other hand, we found out some characteristics of municipalities population age structure, their

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[4] Pure rural municipalities are municipalities which are not located in town regions.

income levels and employment structure which did not have any statistically significant relationships with municipal government budget expenditure structure.

We bring out some interesting relationships (statistically significant at 95% confidence level) between investigated variables characterizing all Estonian municipalities in 2010:

- The share of young people (ages 7–18) in the municipalities population had a positive correlation with education expenditures per inhabitant (0.35), but also with share of leisure and culture expenditures in the municipal budget (0.18) and negative correlations with share of housing and utility expenditures (-0.26) in the municipal government budget;
- The proportion of 19 to 64 year olds in the municipalities population had positive correlations with education expenditures per inhabitant (0.24) and as a share in the municipal budget (0.23), but negative correlations with share of housing and utility expenditures (-0.28) municipality government budget;
- The proportion of elderly (age 65 and older) in municipality population had negative correlations with education expenditure (-0.23), but also with leisure and culture expenditures (-0.19) per municipality inhabitant;
- The demographic labour pressure index (calculated by dividing the number of 5–14 year olds with the number of 55–64 year olds) has a negative correlation with the share of education expenditures in the municipal government budget (-0.26), correlations with other local government expenditure variables were unstable and seem random;
- The dependency ratio had positive correlations with education expenditure level per inhabitant (0.21) and as a share in the municipal budget (0.20), but a negative correlation with the share of housing and utility spending in the municipal government budget (-0.21);
- The job related income level per municipality inhabitant has five statistically significant correlations with characteristics of local public service supply: positive correlations with levels of leisure and culture (0.20), social care (0.32) and elderly (0.26) expenditure per municipality inhabitant, a positive correlation with the share of social care expenditures (0.23), but negative correlation with the share of education expenditures (-0.35) in the municipal government budget;
- The proportion of municipality labour force employed in public sector and income earned by their in public sector have a negative correlation with the share of education expenditures (-0.23) in the municipal government budget, but positive correlations with per capita level of education expenditures (0.19). The proportion of labour force employed in public sector has a positive correlation with the share of leisure and culture expenditures in the municipal government budget (0.23) and also positive correlations with leisure and culture (0.38), housing and utility (0.22), social (0.33) and elderly care (0.31) expenditures per municipality inhabitant;
- Statistically significant relationships were also found between local public service supply characteristics and shares of different private sector activity types (NACE classification) in employment of municipality labour force, but the relationships seemed to be random in their nature;
- The general share of labour force (tax payers) in the municipality population, and salary income per tax payer had no statistically significant correlations with characteristics of local government budget structure.

The results of this analysis show that the income and employment structure of the population of a municipality, which have been neglected in previous empirical studies, have statistically significant correlations with both the share of different public service expenditures in the municipal government budget and with local public service expenditure levels per inhabitant or per certain user group member in the municipality. Therefore, the structure of employment and income may significantly shape the demand for impure local public services. Analysis of these demand side factors will provide a better understanding of problems matching local public services supply and demand.

In general, it should be noted that quite a number of statistically significant correlations were found between characteristics of demand side factors of impure local public services and municipal government budget expenditures on impure public services, but the nature of the relationships system is difficult to understand. Therefore, principal component analysis was carried out on the base of local public service demand side characteristics to bring out the synthetic independent (non-correlated) complex indicators (components) describing in compressed form the main part of information contained in the set of initial variables.

2.3 Principal component analysis

The purpose of principal component analysis is to compress the information contained in a set of variables about the covariance of these variables and get a smaller number of synthetic components that are able to transmit the

main part of the information contained in the original set of factors. Synthetic components are brought out orthogonally transformed (synthetic components are linearly uncorrelated), which allows analysing their influence on the characteristics of local public service supply independently of each other.

The principal component analysis covered 31 variables expected to characterise demand side factors of impure local public services (see Appendix 2), based on which 10 synthetic components where brought out. These components described 94% of the information (variation) contained in the original set of factors of all Estonian municipalities together, 92% of the information contained in the original set of factors of pure rural municipalities in Estonia and 95% of the information contained in the original set of factors of Estonian towns and rural municipalities located in town regions. This means that reducing the number of factors by approximately 70% resulted in only 5% to 8% of information loss.

The synthetic components, initial variables belonging under them and their correlations (component loadings) from 2010 in municipalities in town regions are presented in Appendix 4 and in pure rural municipalities in Appendix 5. We also conducted the principal component analysis for all Estonian municipalities together, the results of that can be seen in Appendix 3. The appendixes 3, 4 and 5 show only variables with component loadings of 0.5 or more. All component notations (F1, F2 etc.) of the paper are based on the components obtained from the principal component analysis of all Estonian municipalities together. This helps us to analyse the result of different municipality groups on a comparable basis. The exact names of the components, however, differ slightly among municipality groups (because of differences in the composition).

We first bring out the general findings that are common in both municipality groups and then move on group specific findings. When looking at the results, it should be remembered, that due to the properties of principal component analysis, the synthetic components do not have synergistic effects between them.

The majority of components are strongly correlated with 2 or 3 similar variables and their content (name) is easy to find out, but some components, primarily F1 and F2, have high level correlations with more diverse initial variables. This also means that their content is harder to bring under a common name. For component F2 it can still be done, but component F1 will be without a specific name in this paper.

It appears, that two of the ten synthetic components, F4 and F8, characterize the population age structure of municipalities and eight components the importance of different economic activity types in ensuring employment and income of the municipalities' population. Most of the initial variables are correlated with only one synthetic component, but a few variables are correlated with multiple components (koguopq_arv, proportion of tax payers working in the private sector in the population, is correlated with components F1 and F2 of pure rural municipalities, and fl_arv, proportion of tax payers working in the construction and real-estate industries as a share in population, is correlated with components F1 and F3 of pure rural municipalities) and some variables are not correlated with any component (e.g. vms_mm, total taxable income per tax payer, and ralot, proportion of 6 year olds and younger as a share in population, are not represented in the pure rural municipalities components).

When comparing the result between the two municipality groups it can be seen, that components F3 to F9 seem to be largely the same among both groups, with only a few minor differences in component compositions. At the same time, the composition of components F1, F2 and F10 (notations based on the results of the group consisting of all Estonian municipalities) differ significantly from each other among the two municipality groups.

The smallest differences among the two municipality groups are, aside from differences in the absolute values of component loadings, with component F3, where the component of municipalities in town regions has one indicator (fl_arv) fewer than the component of pure rural municipalities, and with component F8, where the component of municipalities in town regions has also one indicator (tts) fewer than the component of pure rural municipalities. The difference in the number of variables, however, does not make the components different from each other in terms of what they represent and how they can be named.

Another, more peculiar, difference between the two groups can be seen with component F4. There the number of variables in the component is the same, but the indicators are of opposite signs. When comparing the group results with the overall results (see Appendix 3), it can be seen that the signs of the indicators are same for municipalities in in town regions, and for all municipalities in Estonia together, and opposite for pure rural municipalities. This means in substantive terms that in case of municipalities in town regions (and also for all municipalities in Estonia together), the component F4 represents a high share of working age people in the

population, but in case of pure rural municipalities it represents a high share of non-working age people (primarily elderly) in the population.

Large differences between the two municipality groups can be seen in the composition of component F1. Although the two groups have six common indicators, the group consisting of municipalities in town regions has 5 additional initial variables in the component F1. The significance (based on component loadings) of the initial indicators in the component is, to some extent, also different. Yet another problem with the component F1 is the complexity of its composition. Compared to other components which are composed of variables from similar or same fields, the component F1 consists of variables form very different fields. Because of these problems, it is very difficult to interpret what this component represents.

Even larger differences can be seen with component F2. When looking at the result of the group consisting of municipalities in town regions it can be seen that the component, which in the case of pure rural municipalities and all municipalities in Estonia together represents the importance of private sector and especially manufacturing in ensuring employment and income, is split into two independent components. One component (F2a) represents the importance of private sector in general in ensuring employment and income and the second component (F2b) represents separately the importance of manufacturing in ensuring employment and income.

The largest difference between the two municipality groups is with component F10. It can be seen from the results of the principal component analysis, that the component, which in the case of pure rural municipalities and all municipalities in Estonia together represents the importance of wholesale and retail trade in ensuring employment and income, has no importance for municipalities in town regions, because none of the initial variables has a component loading of 0.5 or higher. The initial variables, which are significant for pure rural municipalities in component F10, are for municipalities in town regions significant in component F1. There is also an interesting difference in the composition of component F10 between pure rural municipalities and all Estonian municipalities together – the only common variable the pure rural municipality groups has (gvms) with the other municipality group, is of opposite sign.

The results of the principal component analysis show that components characterizing the structure of impure local public services' demand side factors can be found. However, in order to better understand the influence of the found components on the supply of impure local public services, other analysis methods are required.

2.4 Regression analysis

Regression analysis was used to find out the intensity and extent of relationship of the synthetic components characterizing demand side factors of impure local public services with the variables describing the supply of impure local public services and how they differ among the two municipality groups. Since the synthetic components (F_i) are centred (mean=0), the regression intercept (y_k) describes the arithmetic mean of the modelled local public service expenditure (or supply) variable (Y) in the analysed municipality group. Since the synthetic components (F_i) are normalized (standard deviation is the measurement unit of variability), the measurement scales of the components are equal and the values of regression coefficients (a_i) show comparable influence intensities of components. Therefore, the regression model used in the analysis is a simple linear regression model:

$$Y = y_k + a_1 F1 + a_2 F2 + \dots a_{10} F10.$$

Regression analysis was carried out for all local public service expenditure variables. Since education expenditures account for half of a municipal budget in Estonia, we focus first and mainly on those results and give afterwards a short overview of the other results of our regression analysis. The final regression models of education expenditure factors are shown in Table 1. All three models are statistically significant at 95% confidence level in both municipality groups. The table shows components that were in models statistically significant at 90% confidence level.

The coefficients of determination were highest in the models that describe education expenditures per inhabitant (har_in). In case of municipalities in town regions the respective model describes around 54% of variation of this expenditure variable (R^2=0.54). In case of pure rural municipalities the model describes 30% of variation of this expenditure variable. Since the components have a mean value of zero, parameter y_k shows the arithmetic mean of education expenditures per inhabitant in the two municipality groups – 505.9 euros in municipalities in town regions and 461.8 euros in pure rural municipalities. Although the models have relatively good coefficients of determination, the majority of components were found to be statistically insignificant. In the model that

describes the education expenditures per inhabitant of municipalities' in town regions only two components where statistically significant and in the model that describes education expenditures per inhabitant of pure rural municipalities' three components. Component F1 proved statistically significant in both models, although in the model of municipalities in regions, its regression coefficient is more than three times larger than in the model of pure rural municipalities.

Since the components are measured in standard deviation, the regression coefficients show the average variability of the modelled factor. For example, the component F1 causes average variation of education expenditures per inhabitant in Estonian pure rural municipalities in extent of 52.5 euro from the arithmetic mean of education expenditures per inhabitant in Estonian pure rural municipalities (461.8 euro). The scope of variation is therefore 2*52.5 = 105 euro.

The coefficients of determination were second highest in the models that describe the share of education expenditures in the municipal budget (har). The respective model for municipalities in town regions had a coefficient of determination of 0.38 and 5 components where statistically significant (4 at 95% confidence level and one at 90% confidence level). In the case of Estonian rural municipalities the respective variable of service supply is influenced by six components, but the coefficient of determination (R^2=0.25) is lower than in the model for municipalities in town regions and also lower than in the previous model that described education expenditures per inhabitant of pure rural municipalities'. In addition, the majority of components are statistically significant at 90% confidence level but not at 95%, i.e. the influence of most components on the share of education expenditures in the municipal government budget is not as clear as would be preferred. When comparing the model for municipalities in town regions with the model for pure rural municipalities, it can be seen that the models had four statistically significant components (F1, F5, F6, F8), but the regression coefficients were always higher in the model that describe the share of education expenditures in the local government budget in municipalities in town regions.

Table 1. Regression models of education expenditure variables based on demand side components in Estonian municipalities in town regions and pure rural municipalities in 2010.

	Municipalities in town regions						Pure rural municipalities					
	har		har_in		har18		har		har_in		har18	
	a_i	P > |t|	a_i	P > |t|	a_i	P > |t|	a_i	P > |t|	a_i	P > |t|	a_i	P > |t|
F1	3.6	0.00	182.0	0.00	485.9	0.00	-1.6	0.07	52.5	0.00		
F2									-38.6	0.01	-241.5	0.00
F3					-158.3	0.06	1.7	0.06				
F4	2.5	0.01										
F5	2.6	0.01	33.7	0.09			1.8	0.05				
F6	1.8	0.06					1.6	0.08				
F7							1.8	0.05				
F8	3.6	0.00					2.9	0.00	59.2	0.00		
F9											124.7	0.06
F10												
y_k	50.9		505.9		2427.4		49.7		461.8		2298.2	
Prob > F	0.0000		0.0000		0.0000		0.0005		0.0000		0.0208	
R^2	0.3802		0.5356		0.3654		0.2516		0.3022		0.1758	

Source: compiled by the authors.

Models for education expenditures per child under age 19 in (har18) had the lowest coefficients of determination of the three regression models of education expenditures. Similarly to previous models the coefficient of determination was considerably higher in the respective model for municipalities in town regions – R^2=0.36, compared to R^2=0.18 in the model for pure rural municipalities. Both models had one component that was statistically significant at the 95% confidence level and one component that was statistically significant at the 90% confidence level. However, unlike the previous regression models for education expenditures, the two

models for education expenditures per child under age 19 in 2010 did not have common components in models for different types of municipalities.

In conclusion, it should be noted that overall the synthetic components describe 18% to 54% of variation of the education expenditure variables of Estonian municipalities. This is a fairly high description level, which may have been caused partly because of targeted grants from central government budget that on the normative base are common for all municipalities. However, the results are significantly different depending on the group of municipalities. The coefficients of determination of the regression models of municipalities in town regions are 1.5 to 2.1 times higher than the coefficients of determination of the regression models of pure rural municipalities. One explanation for this may be that in municipalities that have larger schools (municipalities in town regions) the normative influence of targeted grants from central government manifests itself more strongly than in pure rural municipalities which usually have smaller schools.

Regression models for the other local public service expenditure variables had lower coefficients of determination. More importantly, depending of the municipality group, half or more of the regression models were not statistically significant at 95% confidence level.

Pure rural municipalities had five regression models that were statistically significant:

- the regression model of leisure, culture and religious expenditures per inhabitant (kult_in) had the highest coefficient of determination (R^2=0.26) from the rest of the local public service expenditure variables. The model had three components (F1, F2 and F10) that were statistically significant at 95% confidence level and two component (F5 and F8) that was statistically significant at 90% confidence level;
- the regression model of social care expenditures per inhabitant (sots_in) had a coefficient of determination of R^2=0.20 and two components (F1 and F2) were statistically significant at 95% confidence level;
- the regression model of the share of housing and utility expenditures in the municipal budget (komm) had a coefficient of determination of R^2=0.19, but the model had only one component (F9) that was statistically significant at 95% confidence level and one component (F7) that was statistically significant at 90% confidence level;
- the regression model of eldercare expenditures per inhabitant (vana_in) had a coefficient of determination of R^2=0.17 and two components (F1 and F2) were statistically significant at 95% confidence level;
- the regression model of the share of eldercare expenditures in the municipal budget (vana) was also statistically significant. The model had a coefficient of determination of R^2=0.16 and only two components (F2 and F3) were statistically significant at 95% confidence level.

In municipalities in town regions, only one regression model of other variables describing expenditure on impure local services was statistically significant at 95% confidence level. Interestingly, it was the model for leisure, culture and religious expenditures per inhabitant (kult_in), which was also the regression model with the highest coefficient of determination of pure rural municipalities. The model had four components (F2, F4, F8 and F9) that were statistically significant at 95% confidence level and one component (F5) that was statistically significant at 90% confidence level. The coefficient of determination of the model was R2=0.25.

In conclusion, it can be summarized that:

- Expect for education expenditure, only a small share of variation of local public service expenditure levels and structure can be explained by local public service demand side components;
- The influence of statistically significant components can in most cases be explained logically, but in some cases, they need further more thorough investigation. A large number of statistically significant correlations between municipal government budget expenditure level and structure characteristics and local public service demand side factors gave hope that the coefficients of determination will be higher than they finally were;
- Components F1, F2 and F8 have the strongest and most versatile influence on local public service supply characteristic – component F1 was found to be statistically significant (at least 90% confidence level) in eight statistically significant regression models, component F2 in six models and component F8 in 5 models;
- All of the 10 components were statistically significant (at least 90% confidence level) in at least one statistically significant regression model, though component F10 in only one model and components F4, F6, F7 and F9 in two models.

Summary

Overcoming the dissatisfaction with the provision of local public services in municipalities is an important development problem in Estonian political decision making and from research aspect as well. From one side it is necessary to strengthen the ability of municipalities to supply local public services. This article tackles the problem that in addition to supply capability the ability to match the supply to the demand for local public services and to demand changes is of equal importance. This study concentrates on demand side factors of impure (mixed, quasi) local public services.

On the base of existing theoretical studies we can point out that the main factors affecting demand for impure public services are population age structure and to a lesser extent the employment and income structure of the population. Probably because of lack of usable data, the existing empirical studies have mostly used factors characterising the population age structure in the role of demand side factors. In this study we add factors characterising the level and structure of income and employment (according of NACE2008 classification) of the inhabitants of Estonian municipalities to the demand side factors. The empirical analysis focused on 97 municipalities in town regions, and 116 pure rural municipalities in Estonia. The analysis was carried out based on the data 2010.

The correlation analysis conducted here confirms the existence of relationships between factors characterizing the supply and demand of impure local public services, meaning that population structure as well as employment and income levels and the structure of the population have statistically significant correlative relationships with the expenditure structure of the municipal budget and local public service expenditures level per inhabitant. The direction of the relationships is usually logical and the dense network of relationships reveals a system in these relationships.

The first step of the analysis in this study show that local public service supply variables (the share of expenditures in the municipal budget and expenditures per inhabitant) in Estonian municipalities are statistically significantly correlated with local public service demand side variables (population age structure, employment and income levels, employment and income structure by economic activity).

Because the set of local public service demand side variables was quite large (31 variables) and different variables have statistical correlations between them, the correlation coefficients between demand and supply side variables might be misleading and thus complicate our understanding of the nature of the relationships. Therefore, as a second step, we have systematically analysed the internal relationships of the demand side variables with help of the principal component analysis method and identified the independent components that characterize local public service demand. The principal component analysis gave 10 synthetic components instead of the original 31 variables, which described 92% to 95% of the information (variation of values) contained in the original set of factors, depending on the municipality group.

After conducting principal component analysis and synthesising statistically independent components (that means the problem of multicollinearity was overcome), we were able to use multiple regression models for providing a more complex description of the effects of demand side factors. The results of the regression analysis show that the supply of impure local public services can be modelled with characteristics describing the demand side factors of impure local public services, but expect for education expenditure, only a small share of variation of local public service expenditure levels and structure can be explained using simple linear regression models. The usefulness of more complex regression models requires separate investigation.

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Appendix 1. Characteristics describing the supply of impure local public services in 2010

Name	Characteristics used in the analysis
har	Share of education expenditures in the municipal budget (%)
kult	Share of leisure, culture and religious expenditures in the municipal budget (%)
komm	Share of housing and utility expenditures in the municipal budget (%)
sots	Share of social care expenditures in the municipal budget (%)
vana	Share of eldercare expenditures in the municipal budget (%)
ttu	Share of social care expenditures directed at unemployed in the municipal budget (%)
har_in	Education expenditures per inhabitant (euro)
kult_in	Leisure, culture and religious expenditures per inhabitant (euros)
komm_in	Housing and utility expenditures per inhabitant (euro)
sots_in	Social care expenditures per inhabitant (euro)
vana_in	Eldercare expenditures per inhabitant (euro)
ttu_in	Social care expenditures directed at unemployed per inhabitant (euros)
har18	Education expenditures per child under age 19 (euro)

Source: compiled by the authors.

Appendix 2. Characteristics describing the demand side factors of impure local public services in 2010

Name	Characteristics used in the analysis
ralot	Proportion of 6 year olds and younger in the population (%)
ranot	Proportion of 7 to 18 year olds in the population (%)
ratot	Proportion of 19 to 64 year olds in the population (%)
ravot	Proportion of 65 year olds and older in the population (%)
tts	Demographic labour pressure index
ylal	Dependency ratio (%)
ttuot	Proportion of unemployed in the population (%)
vms_in	Total taxable income per inhabitant (euro)
vms_mm	Total taxable income per tax payer (euro)
amm_ arv	Proportion of tax payers working in the agriculture, forestry and fishing industries (NACE classification) in the population (%)

avms	Ratio of taxable income earned in the agriculture, forestry and fishing industries (NACE classification) to total taxable income (%)	
cmm_ arv	Proportion of tax payers working in the manufacturing industry (NACE classification) in the population (%)	
cvms	Ratio of taxable income earned in the manufacturing industry (NACE classification) to total taxable income (%)	
fmm_arv	Proportion of tax payers working in the construction industry (NACE classification) in the population (%)	
fvms	Ratio of taxable income earned in the construction industry (NACE classification) to total taxable income (%)	
lmm_arv	Proportion of tax payers working in the real-estate industry (NACE classification) in the population (%)	
lvms	Ratio of taxable income earned in the real-estate industry (NACE classification) to total taxable income (%)	
fl_arv	Proportion of tax payers working in the construction and real-estate industries (NACE classification) in the population (%)	
fl	Ratio of taxable income earned in the construction and real-estate industries (NACE classification) to total taxable income (%)	
gmm_arv	Proportion of tax payers working in the wholesale and retail trade and motor vehicle and motorcycle repair industries (NACE classification) in the population (%)	
gvms	Ratio of taxable income earned in the wholesale and retail trade and motor vehicle and motorcycle repair industries (NACE classification) to total taxable income (%)	
omm_arv	Proportion of tax payers working in the fields of public administration, national defence and compulsory social security (NACE classification) in the population (%)	
ovms	Ratio of taxable income earned in the fields of public administration, national defence and compulsory social security (NACE classification) to total taxable income (%)	
pmm_arv	Proportion of tax payers working in education (NACE classification) in the population (%)	
pvms	Ratio of taxable income earned in education (NACE classification) to total taxable income (%)	
qmm_arv	Proportion of tax payers working in the health care and social care industries (NACE classification) in the population (%)	
qvms	Ratio of taxable income earned in the health care and social care industries (NACE classification) to total taxable income (%)	
opq_arv	Proportion of tax payers working in the public sector (activities O, P and Q according to the NACE classification) in the population (%)	
opq	Ratio of taxable income earned in the public sector (activities O, P and Q according to the NACE classification) to total taxable income (%)	
koguopq_arv	Proportion of tax payers working in the private sector in the population (%)	
koguopq	Ratio of taxable income earned in the private sector to total taxable income (%)	

Source: compiled by the authors.

Appendix 3. Synthetic components characterizing the structure of impure local public services' demand side factors in 2010 in all Estonian municipalities together.

Synthetic component	Initial variable	Component loading
F1	omm_arv	0.94
	opq_arv	0.93
	vms10_in	0.89
	koguopq_arv	0.81
	fl_arv	0.73
	gmm_arv	0.82
	ralot	0.73
	vms_mm	0.66
	fmm_arv	0.68
F2 – High importance of the private sector (especially manufacturing) in ensuring employment and income	koguopq	0.92
	ovms	-0.84
	cmm_arv	0.57
	cvms	0.53
	opq	-0.92

	fvms	0.97
F3 – High importance of the construction industry (and real-estate activities related to it) in ensuring employment and income	fl	0.97
	fmm_arv	0.64
	ratot	0.94
F4 – A high share of non-working age people (primarily elderly) in the population	ylal	-0.85
	ravot	-0.86
F5 – High importance of agriculture, forestry and fishing industries in ensuring employment and income	amm_arv	-0.92
	avms	-0.88
F6 – High importance of health care and social care industries in ensuring employment and income	qmm_arv	0.92
	qvms	0.94
F7 – High importance of the education sector in ensuring employment and income	pvms	0.97
	pmm_arv	0.83
F8 – A high share of under 19 year olds in the population	ranot	0.92
	tts	0.56
F9 – High importance of the real estate industry in ensuring employment and income	lvms	0.89
	lmm_arv	0.69
F10 – High importance of wholesale and retail trade, and motor vehicle and motorcycle repair industries in ensuring employment and income	gvms	-0.57

Source: compiled by the authors.

Appendix 4. Synthetic components characterizing the structure of impure local public services' demand side factors in 2010 in Estonian municipalities in town regions.

Synthetic component	Initial variable	Component loading
F1	omm_arv	0.94
	opq_arv	0.94
	vms_in	0.93
	koguopq_arv	0.86
	fl_arv	0.75
	gmm_arv	0.91
	ralot	0.78
	vms_mm	0.76
	fmm_arv	0.7
	tts	0.59
	gvms	0.57
F2a– High importance of the private sector in general in ensuring employment and income	koguopq	0.89
	ovms	-0.81
	opq	-0.89
F2b – High importance of the manufacturing sector in ensuring employment and income	cmm_arv	0.81
	cvms	0.72
F3 – High importance of the construction industry (and real-estate activities related to it) in ensuring employment and income	fvms	0.96
	fl	0.96
	fmm_arv	0.64
F4 – A high share of working age people in the population	ratot	0.93
	ylal	-0.86
	ravot	-0.88
F5 – High importance of agriculture, forestry and fishing industries in ensuring employment and income	amm_arv	0.89
	avms	0.87

	qmm_arv	0.9
F6 – High importance of health care and social care industries in ensuring employment and income	qvms	0.87
F7 – High importance of the education sector in ensuring employment and income	pvms	0.97
	pmm_arv	0.87
F8 – A high share of under 19 year olds in the population	ranot	0.8
F9 – High importance of the real estate industry in ensuring employment and income	lvms	0.86
	lmm_arv	0.73

Source: compiled by the authors.

Appendix 5. Synthetic components characterizing the structure of impure local public services' demand side factors in 2010 in Estonian pure rural municipalities.

Synthetic component	Initial variable	Component loading
F1	omm_arv	0.95
	opq_arv	0.94
	vms_in	0.85
	koguopq_arv	0.63
	fl_arv	0.57
	gmm_arv	0.55
F2 – High importance of the private sector (especially manufacturing) in ensuring employment and income	koguopq	0.91
	ovms	-0.88
	cmm_arv	0.67
	cvms	0.58
	opq	-0.91
	koguopq_arv	0.58
F3 – High importance of the construction industry (and real-estate activities related to it) in ensuring employment and income	fvms	0.96
	fl	0.94
	fmm_arv	0.71
	fl_arv	0.64
F4 – A high share of working age people in the population	ratot	-0.95
	ylal	0.88
	ravot	0.85
F5 – High importance of agriculture, forestry and fishing industries in ensuring employment and income	amm_arv	0.9
	avms	0.87
F6 – High importance of health care and social care industries in ensuring employment and income	qmm_arv	0.96
	qvms	0.96
F7 – High importance of the education sector in ensuring employment and income	pvms	0.96
	pmm_arv	0.93
F8 – A high share of under 19 year olds in the population	ranot	0.87
	tts	0.71
F9 – High importance of the real estate industry in ensuring employment and income	lvms	0.87
	lmm_arv	0.79
F10 – High importance of wholesale and retail trade, and motor vehicle and motorcycle repair industries in ensuring income and employment	gvms	0.73
	gmm_arv	-0.57

Source: compiled by the authors.