

# The efficiency of public primary education in Croatian cities

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# Motivation

- To encourage **policymakers** to **improve the efficiency** of public primary education.
- To **help** our **children receive better education**.
- PISA 2022 : Croatian fifteen-year-old **primary school pupils scored below the OECD average in math** (OECD, 2023)
- The efficiency of public primary education at the level of Croatian cities **has not been measured**.



# The aim of the research

- In which cities budgetary resources for public primary education could be spent more efficiently?
- DEA - VRS method
- Focus is on public primary schools established by 36 cities, 2019 - 2022



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# 1. The efficiency of local public service - definition

- **Challenging.**
  - **Technical efficiency** - maximization of outputs to inputs (Farrell, 1957)
  - **An input-output analysis** - the efficiency of the LG, i.e. its ability to offer as many better-quality public services as possible with limited resources (Junqueira, 2015; López et al., 2020).
  - **Input variables** - the resources necessary for the provision of public services
  - **Output variables** - public services provided
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## 2. How did others measured the efficiency of public primary education?

- **No single definition.**
  - It is a complex concept, **depending on the input/output criteria/variables used for measuring it.**
  - Each analysis of the efficiency of primary education referred only to the (in)efficiency concerning the variables used.
  - It is **difficult to choose output variables** because the focus could/should be on **several activities/goals of primary education:**
    - pupils' grades,
    - pupils discipline,
    - enrichment of school curricula,
    - schools' cultural and public activities,
    - the satisfaction of pupils, parents, and teachers, etc.
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## 2. How did others measure the efficiency of public primary education?

- As it is difficult to measure services provided by primary education (output variables) directly and because of data limitations → proxy variables.
- The **proxy output variables** used in previous studies:
  - **the number of pupils in local primary schools**
  - **the number of schools in the municipality**
  - the percentage of the population of the municipality that is literate
  - pupil attendance per school
  - the number of hours of teaching per school in each municipality
  - the pupils who passed the class per school.
- The results from different countries mainly show **great differences in efficiency scores among municipalities** and on average considerable room for improving their efficiencies (e.g. Ashworth et al., 2014; Basílio et al., 2020; Bischoff, Bönisch, Haug, & Illy, 2013; Bönisch, Haug, Illy, & Schreier, 2011; Geys, 2006; Lampe et al., 2015; Nogueira et al., 2018).

### 3. How did we measure it?

Table 1.

| Variable                      |          | Definition and measurement   | Source                  |
|-------------------------------|----------|--|-------------------------|
| <b>INPUT</b>                  |          |  |                         |
| <b>Expenditures per pupil</b> | $x_{1j}$ | Budget expenditures for primary education per pupil. Data from a consolidated report on expenditures according to functional classification. | MF (2024); MZOM (2023a) |
| <b>OUTPUTS</b>                |          |  |                         |
| <b>Schools*</b>               | $y_{1j}$ | The total number of schools for primary education at the beginning of the school year.   | MZOM (2023a)            |
| <b>Pupils</b>                 | $y_{2j}$ | The total number of pupils in primary schools at the beginning of the school year.   | MZOM (2023a)            |
| <b>Classes</b>                | $y_{3j}$ | Number of classes in primary schools at the beginning of the school year.  | MZOM (2023a)            |
| <b>Grades</b>                 | $y_{4j}$ | Average grades of all pupils in all classes in primary school at the end of the school year.   | MZOM (2023b)            |
| <b>Pupils per class</b>       | $y_{5j}$ | The average number of pupils per primary school class at the beginning of the school year.   | MZOM (2023a)            |

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\* Primary schools can have branch schools (and they are included in our analysis).

The input variable (expenditures per pupil) refers to the 2019-2022 period, while outputs (schools, pupils, classes, average grades of all pupils in all classes and average number of pupils per class) denote values for the school years 2019/2020-2022/2023.



### 3. How did we measure it?

- Most authors used the deterministic non-parametric frontier method – Data Envelopment Analysis (DEA) – VRS
  - This is the most widely used and safest approach to avoid possible misspecification (Simar & Wilson, 2002)
  - A method of linear programming that limits inputs from below, i.e. **requires a minimum of inputs for a maximum number of outputs** (limits outputs from above)
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## 4. Research results

Table 2. Descriptive statistics, individual years from 2019 to 2022

| Variable                      | Min | Mean  | Median | Max    | Standard deviation |
|-------------------------------|-----|-------|--------|--------|--------------------|
| <b>Input</b>                  |     |       |        |        |                    |
| <b>Expenditures per pupil</b> | 809 | 3,513 | 3,439  | 7,854  | 759                |
| <b>Outputs</b>                |     |       |        |        |                    |
| <b>Schools</b>                | 3   | 16    | 11     | 136    | 22                 |
| <b>Pupils</b>                 | 542 | 4,598 | 2,107  | 62,852 | 10,166             |
| <b>Classes</b>                | 27  | 246   | 128    | 3,085  | 496                |
| <b>Grades</b>                 | 4.1 | 4.5   | 4.5    | 4.7    | 0.1                |
| <b>Pupils per class</b>       | 13  | 17    | 18     | 21     | 2                  |

Source: Authors.



# 4. Efficiency score results

| City             | 2019 | 2020 | 2021 | 2022 | 2019-2022 |
|------------------|------|------|------|------|-----------|
| Zagreb           | 1    | 1    | 1    | 1    | 4.00      |
| Zadar            | 1    | 0.91 | 0.95 | 1    | 3.86      |
| Makarska         | 0.85 | 1    | 1    | 0.93 | 3.78      |
| Samobor          | 0.91 | 0.96 | 0.98 | 0.91 | 3.76      |
| Velika Gorica    | 0.78 | 1    | 1    | 0.96 | 3.74      |
| Zaprešić         | 0.95 | 0.88 | 0.89 | 1    | 3.72      |
| Split            | 0.82 | 0.88 | 1    | 0.97 | 3.67      |
| Varaždin         | 0.74 | 0.95 | 0.95 | 0.92 | 3.56      |
| Koprivnica       | 0.98 | 1    | 0.82 | 0.70 | 3.50      |
| Pula - Pola      | 0.80 | 0.89 | 0.88 | 0.79 | 3.36      |
| Dubrovnik        | 0.52 | 0.87 | 1    | 0.93 | 3.32      |
| Vrbovec          | 1    | 0.78 | 0.75 | 0.72 | 3.25      |
| Opatija          | 0.73 | 0.79 | 0.84 | 0.82 | 3.18      |
| Đurđevac         | 0.36 | 0.94 | 0.92 | 0.86 | 3.08      |
| Šibenik          | 0.55 | 0.85 | 0.86 | 0.79 | 3.05      |
| Bjelovar         | 0.64 | 0.68 | 0.86 | 0.84 | 3.02      |
| Požega           | 0.67 | 0.69 | 0.85 | 0.80 | 3.01      |
| Rijeka           | 0.64 | 0.77 | 0.83 | 0.76 | 3.00      |
| Osijek           | 0.59 | 0.80 | 0.82 | 0.78 | 2.99      |
| Krapina          | 0.50 | 0.81 | 0.8  | 0.71 | 2.82      |
| Vinkovci         | 0.47 | 0.69 | 0.82 | 0.82 | 2.80      |
| Karlovac         | 0.47 | 0.76 | 0.79 | 0.75 | 2.77      |
| Poreč - Parenzo  | 0.61 | 0.71 | 0.72 | 0.61 | 2.65      |
| Rovinj - Rovigno | 0.53 | 0.69 | 0.7  | 0.69 | 2.61      |
| Slavonski Brod   | 0.33 | 0.71 | 0.8  | 0.72 | 2.56      |
| Sisak            | 0.36 | 0.74 | 0.74 | 0.69 | 2.53      |
| Križevci         | 0.45 | 0.66 | 0.68 | 0.63 | 2.42      |
| Kutina           | 0.38 | 0.68 | 0.7  | 0.64 | 2.40      |
| Umag - Umago     | 0.42 | 0.47 | 0.65 | 0.73 | 2.27      |
| Gospić           | 0.23 | 0.66 | 0.7  | 0.67 | 2.26      |
| Čakovec          | 0.34 | 0.63 | 0.65 | 0.62 | 2.24      |
| Labin            | 0.46 | 0.59 | 0.6  | 0.54 | 2.19      |
| Crikvenica       | 0.40 | 0.51 | 0.63 | 0.60 | 2.14      |
| Pazin            | 0.29 | 0.62 | 0.66 | 0.56 | 2.13      |
| Virovitica       | 0.22 | 0.56 | 0.64 | 0.61 | 2.03      |
| Vukovar          | 0.27 | 0.56 | 0.56 | 0.54 | 1.93      |

## 4. Research results

- Around 90% of cities (depending on the year of observation) did not fully use their inputs, i.e. they could have had better output variables with the same level of inputs and consequently significantly increased their efficiency.
- For instance, in 2019, as many as 40% of cities operated below 50% of their capabilities (some only at 20%), thus failing to produce 50-80% more output.



## 4. Summary of results for 36 cities' public primary education efficiency

| Efficiency interval | 2019     |             | 2020     |           | 2021     |             | 2022      |             |
|---------------------|----------|-------------|----------|-----------|----------|-------------|-----------|-------------|
|                     | No.      | %           | No.      | %         | No.      | %           | No.       | %           |
| [0.2, 0.3)          | 4        | 11.1        | 0        | 0         | 0        | 0           | 0         | 0           |
| [0.3, 0.4)          | 6        | 16.7        | 0        | 0         | 0        | 0           | 0         | 0           |
| [0.4, 0.5)          | 5        | 13.9        | 1        | 2.8       | 0        | 0           | 0         | 0           |
| [0.5, 0.6)          | 5        | 13.9        | 4        | 11.1      | 2        | 5.6         | 3         | 8.3         |
| [0.6, 0.7)          | <b>4</b> | <b>11.1</b> | <b>9</b> | <b>25</b> | <b>8</b> | <b>22.2</b> | <b>10</b> | <b>27.8</b> |
| [0.7, 0.8)          | 3        | 8.3         | 8        | 22.2      | 6        | 16.7        | 10        | 27.8        |
| [0.8, 0.9)          | 3        | 8.3         | 6        | 16.7      | 11       | 30.6        | 4         | 11.1        |
| [0.9, 1)            | 3        | 8.3         | 4        | 11.1      | 4        | 11.1        | 6         | 16.7        |
| <b>1</b>            | 3        | 8.3         | 4        | 11.1      | 5        | 13.9        | 3         | 8.3         |
| <b>Total</b>        | 36       | 100         | 36       | 100       | 36       | 100         | 36        | 100         |

Source: Authors.

## 5. Conclusions

- Considerable differences among cities and significant room for improvement in the efficiency of public primary education.
  - This is the first step in indicating which cities could improve the efficiency of public primary education in terms of the criteria used in the analysis.
  - National and local governments and researchers should especially focus on cities with the lowest level of efficiency, conducting further analysis.
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## 5. Recommendations

- The selected output variables cannot fully capture the efficiency of primary education. **More output variables are needed.**
  - The national authorities should improve the availability and quality of data concerning public primary education
    - participation and the results of pupils in competitions,
    - number of school employees (teachers, teaching assistants, cleaners, cooks, janitors),
    - the activity of public primary schools focused on the enrichment of school curricula,
    - schools cultural and public activities, etc.
  - Conducting **surveys/interviews to investigate**
    - employees' views in public primary schools and
    - citizens' views on **how they define efficiency in primary education.**
- It would also be interesting to do **case studies** analyzing in-depth reasons for differences in efficiency scores among cities.



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# Thank you!



Source: <https://www.freepik.com>