EIROPAS SOCIĀLAIS FONDS
EIROPAS SAVIENĪBA
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# POLYCENTRIC DEVELOPMENT IN LATVIA AND ITS EVALUATION

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*"Integrated Territorial Management and Governance"*
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# The aim and results of the study

- **The aim:** to study **the level of polycentric development** in Latvia and its regions by using mathematical methods (*the innovation*)
- **The results:** Empirical analysis and interpretation of the obtained results confirm trends towards monocentric development in five Latvian regions and country in general

# The tasks of the study

**Morphological prospective**

- calculation of «Primacy of the biggest/main city»
- to identify spatial form (*national level*)
- the indicators of polycentric development (*regional level*)

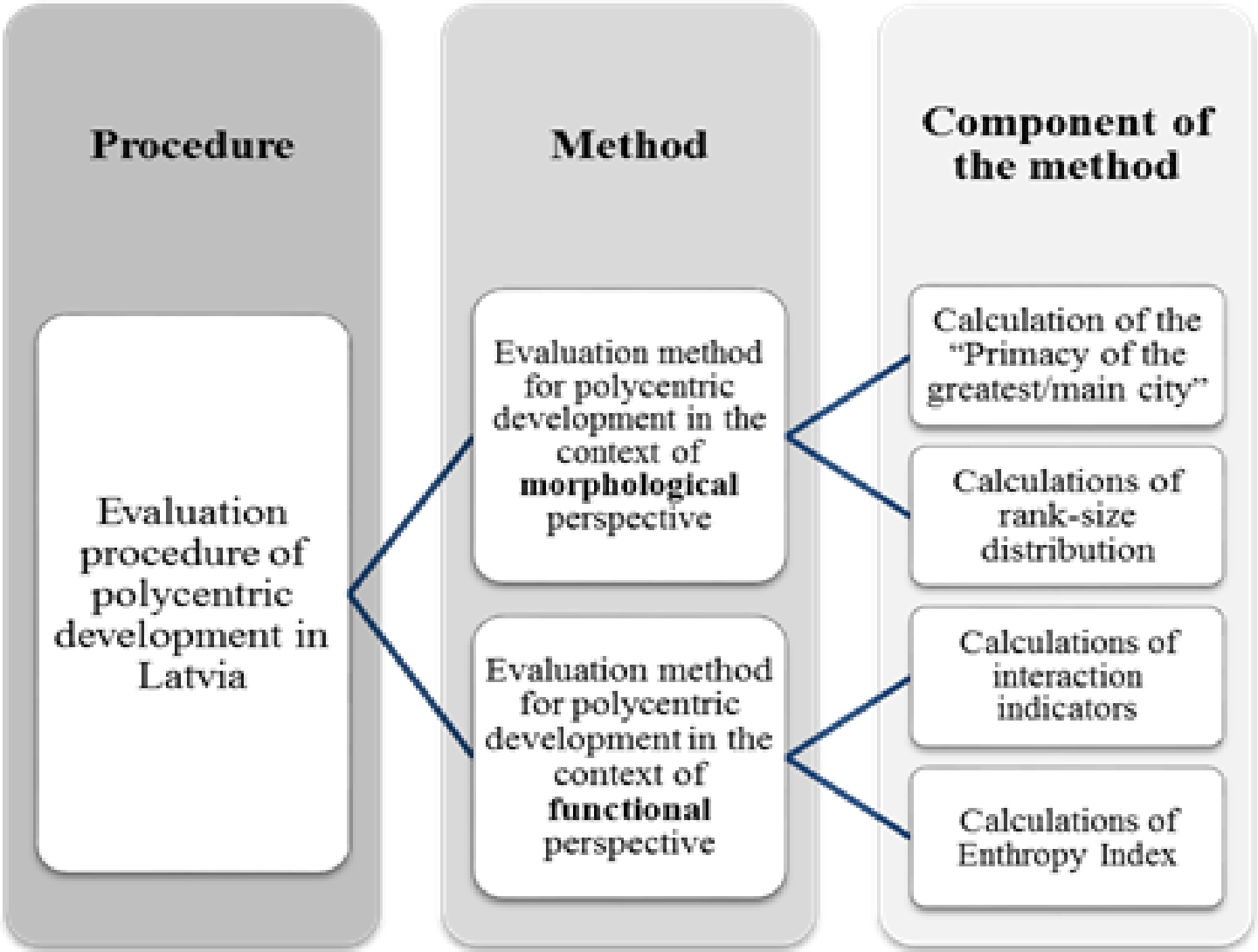
**Functional prospective**

- the calculation of «Entropy index» indicator (*regional level*)
- functional relationship among regional nodes

# Research scientific methods

- Logical analyses and synthesis methods. Monographic and analytical method
- Logically constructive method. Scientific induction and deduction method
- Graphical method
- Statistical method of data processing. Descriptive statistics
- Cartographical method
- General mathematical methods – grouping, comparison, ranging, regression analyses
- SPSS (Statistical Package for the Social Sciences) software 19.0 Windows version

# Approach system for the polycentric development evaluation in Latvia



# Polycentric development level - morphological prospective

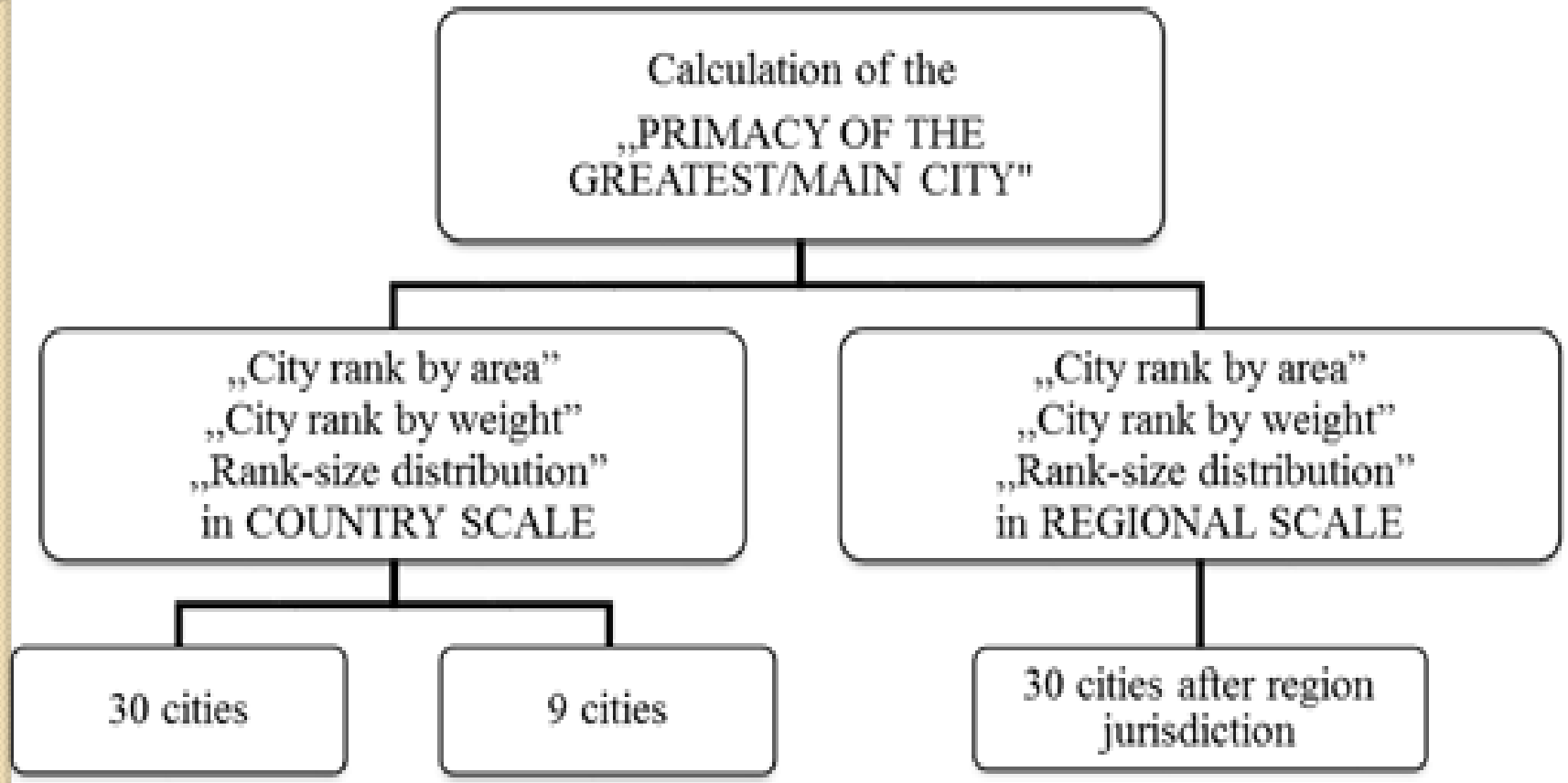
Method developed by P.Veneri and D.Burglassi (2010)

- the mathematical calculations of «the primacy of the biggest city»
- the rank-size distribution

In research improved method of P.Veneri and D.Burgalassi

- used additional evaluation criterion
- formula for calculations with regression analysis was provided

# Components of polycentric development level method in morphological perspective



# Indicators of polycentric development in Latvian regions

**30 development centres** in **5 planning regions**
(Riga, Vidzeme, Kurzeme, Zemgale, and Latgale)

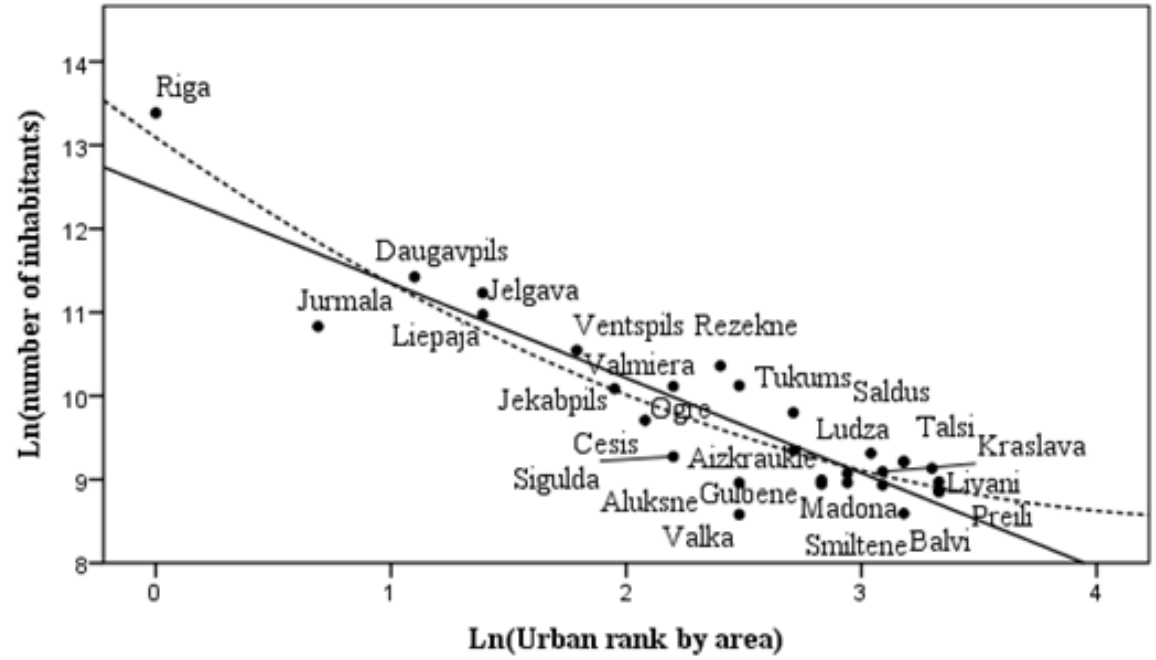
- centre of international significance (Riga)
- centres of national significance (Daugavpils, Jelgava, Jekabpils, Liepaja, Rezekne, Valmiera, Ventspils and Jurmala)
- centres of regional significance (Kuldiga, Talsi, Tukums, Saldus, Dobele, Bauska, Ogre, Aizkraukle, Sigulda, Cesis, Limbazi, Smiltene, Aluksne, Gulbene, Balvi, Preili, Livani, Ludza, Kraslava, Madona, Valka)

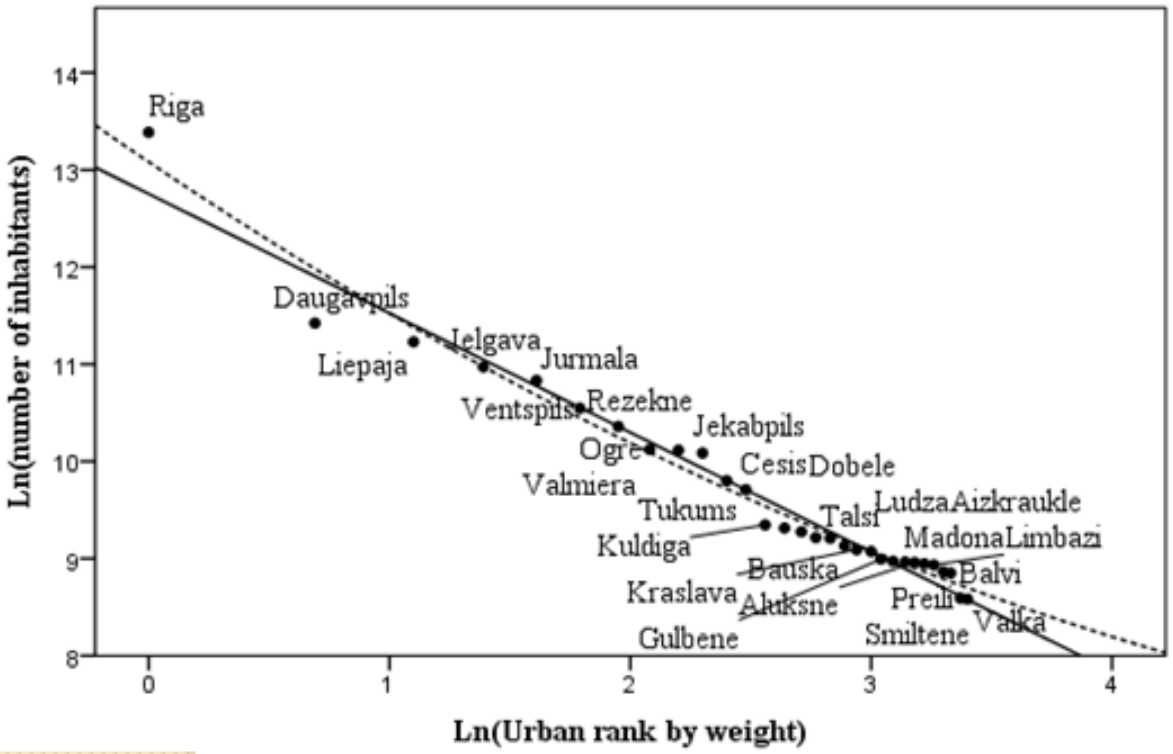
| Year | Population number in planning regions | | | | |
|---|---|---|---|---|---|
| | Kurzeme | Latgale | Riga | Vidzeme | Zemgale |
| 1989 | 204 718 | 222 698 | 1 043 209 | 96 170 | 141 777 |
| 1995 | 178 870 | 213 170 | 950 768 | 88 320 | 126 023 |
| 2000 | 172 295 | 205 249 | 887 103 | 88 406 | 123 258 |
| 2005 | 163 164 | 190 089 | 829 687 | 84 960 | 120 529 |
| 2010 | 153 248 | 171 360 | 788 089 | 79 488 | 114 681 |
| 2012 | 145 971 | 162 584 | 762 332 | 75 568 | 109 285 |

The population number in 30 cities according to Latvian regions, 1989-2012

# The determination results of „City rank after its area" and „City rank after its weight" for development centres of international, national and regional significance in Latvia (30 cities), national level, 2012

| No. | City | Area, km² | City rank after its area | Population number | City weight | City rank after its weight |
|---|---|---|---|---|---|---|
| 1. | Liepaja | 60 | 4 | 75372 | 0,061 | 3 |
| 2. | Kuldiga | 13 | 15 | 11456 | 0,009 | 13 |
| 3. | Saldus | 10 | 21 | 11091 | 0,009 | 14 |
| 4. | Talsi | 8 | 24 | 9984 | 0,008 | 17 |
| 5. | Ventspils | 46 | 6 | 38068 | 0,030 | 6 |
| 6. | Balvi | 5 | 28 | 6979 | 0,006 | 28 |
| 7. | Daugavpils | 72 | 3 | 91478 | 0,074 | 2 |
| 8. | Kraslava | 9 | 22 | 8887 | 0,007 | 19 |
| 9. | Livani | 5 | 28 | 7887 | 0,006 | 22 |
| 10. | Ludza | 11 | 19 | 8715 | 0,007 | 20 |
| 11. | Preili | 5 | 28 | 7079 | 0,006 | 27 |
| 12. | Rezekne | 17 | 11 | 31559 | 0,025 | 7 |
| 13. | Riga | 307 | 1 | 650478 | 0,519 | 1 |
| 14. | Jurmala | 100 | 2 | 50616 | 0,040 | 5 |
| 15. | Limbazi | 9 | 22 | 7589 | 0,006 | 26 |
| 16. | Ogre | 14 | 12 | 24931 | 0,020 | 8 |
| 17. | Sigulda | 18 | 9 | 10665 | 0,008 | 15 |
| 18. | Tukums | 13 | 15 | 18053 | 0,014 | 11 |
| 19. | Valmiera | 18 | 9 | 24722 | 0,020 | 9 |
| 20. | Aluksne | 14 | 12 | 7786 | 0,006 | 24 |
| 21. | Cesis | 19 | 8 | 16471 | 0,013 | 12 |
| 22. | Gulbene | 12 | 17 | 8047 | 0,006 | 21 |
| 23. | Madona | 11 | 19 | 7817 | 0,006 | 23 |
| 24. | Smiltene | 8 | 24 | 5390 | 0,004 | 29 |
| 25. | Valka | 14 | 12 | 5335 | 0,004 | 30 |
| 26. | Jelgava | 60 | 4 | 58280 | 0,046 | 4 |
| 27. | Jekabpils | 26 | 7 | 24017 | 0,019 | 10 |
| 28. | Aizkraukle | 12 | 17 | 7667 | 0,006 | 25 |
| 29. | Bauska | 6 | 27 | 9250 | 0,007 | 18 |
| 30. | Dobele | 8 | 24 | 10071 | 0,008 | 16 |




**Dispersion diagram of 30 cities of international, national and regional significance in Latvia (country scale) in plane of population number and "City rank by weight" and and "City rank by area" with direct linear regression and quadratic regression line, 2012**

# Results of „Rank-size distribution” (national level)

**30 cities:**

| Year | Equation of log-linear regression (1) by area | Equation of log-linear regression (2) by weight | Standardized coefficient | |
|---|---|---|---|---|
| | | | PM(1) | PM(2) |
| 1989. | *Ln(i)=-0.096*Ln(a)+11.135* | *Ln(i)=-1.231*Ln(w)+13.028* | -0.774 | *-0.979* |
| 2012. | *Ln(i)=-1.136*Ln(a)+12.485* | *Ln(i)=-1.228*Ln(w)+12.753* | -0.824 | *-0.985* |

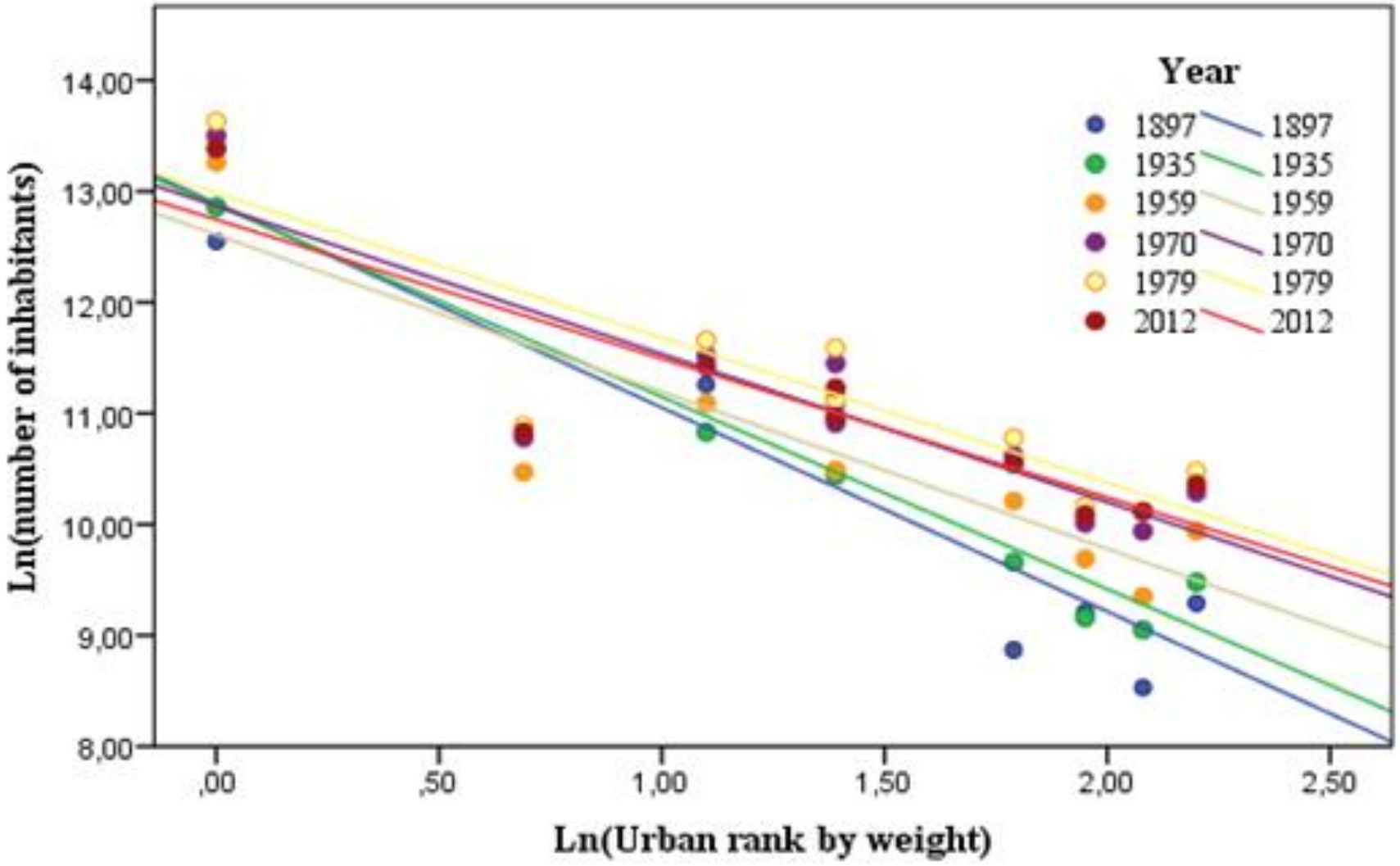
**i – population number, a – City rank by area, w - City rank by weight*

**9 cities**:

| Year | Equation of log-linear regression (1) by area | Equation of log-linear regression (2) by weight | Standardized coefficient | |
|---|---|---|---|---|
| | | | PM(1) | PM(2) |
| 1989. | *Ln(i)=-1.273*Ln(a)+13.052* | *Ln(i)=-1.413*Ln(w)+13.282* | *-0.868* | *-0.967* |
| 2012. | *Ln(i)=-1.251*Ln(a)+12.745* | *Ln(i)=-1.350*Ln(w)+12.917* | *-0.887* | *-0.962* |

**i – number of population, p – city rank by area, s – city rank by weight*

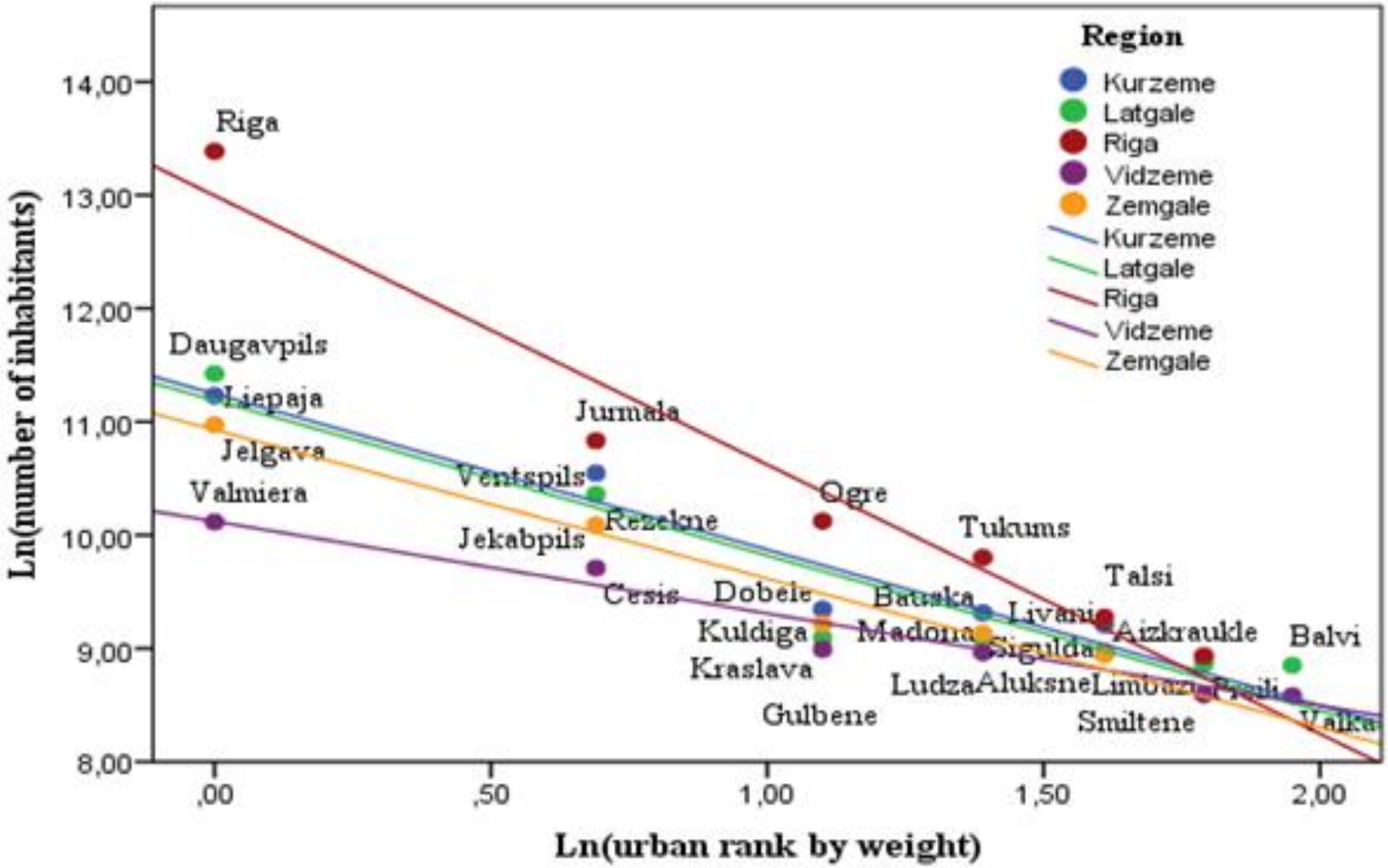
# Dispersion diagram of 9 cities of international and national significance in Latvia (country scale) in plane of population number and "City rank by weight" with direct linear regression, 1897 – 2012



# The determination results of „City rank after its area" and „City rank after its weight" for development centres of international, national and regional significance in Latvia (30 cities), regional level, 2012

| Region | No. | City | Area, km² | City rank after its area | Population number | City weight (R) | City rank after its weight (R) |
|---|---|---|---|---|---|---|---|
| Kurzeme | 1. | Liepaja | 60 | 1 | 75372 | 0,516 | 1 |
| | 2. | Kuldiga | 13 | 3 | 11456 | 0,078 | 3 |
| | 3. | Saldus | 10 | 4 | 11091 | 0,076 | 4 |
| | 4. | Talsi | 8 | 5 | 9984 | 0,068 | 5 |
| | 5. | Ventspils | 46 | 2 | 38068 | 0,261 | 2 |
| Latgale | 1. | Balvi | 5 | 5 | 6979 | 0,043 | 7 |
| | 2. | Daugavpils | 72 | 1 | 91478 | 0,563 | 1 |
| | 3. | Kraslava | 9 | 4 | 8887 | 0,055 | 3 |
| | 4. | Livani | 5 | 5 | 7887 | 0,049 | 5 |
| | 5. | Ludza | 11 | 3 | 8715 | 0,054 | 4 |
| | 6. | Preili | 5 | 5 | 7079 | 0,044 | 6 |
| | 7. | Rezekne | 17 | 2 | 31559 | 0,194 | 2 |
| Riga | 1. | Riga | 307 | 1 | 650478 | 0,853 | 1 |
| | 2. | Jurmala | 100 | 2 | 50616 | 0,066 | 2 |
| | 3. | Limbazi | 9 | 6 | 7589 | 0,010 | 6 |
| | 4. | Ogre | 14 | 4 | 24931 | 0,033 | 3 |
| | 5. | Sigulda | 18 | 3 | 10665 | 0,014 | 5 |
| | 6. | Tukums | 13 | 5 | 18053 | 0,024 | 4 |
| Vidzeme | 1. | Valmiera | 18 | 2 | 24722 | 0,327 | 1 |
| | 2. | Aluksne | 14 | 3 | 7786 | 0,103 | 5 |
| | 3. | Cesis | 19 | 1 | 16471 | 0,218 | 2 |
| | 4. | Gulbene | 12 | 5 | 8047 | 0,106 | 3 |
| | 5. | Madona | 11 | 6 | 7817 | 0,103 | 4 |
| | 6. | Smiltene | 8 | 7 | 5390 | 0,071 | 6 |
| | 7. | Valka | 14 | 3 | 5335 | 0,071 | 7 |
| Zemgale | 1. | Jelgava | 60 | 1 | 58280 | 0,533 | 1 |
| | 2. | Jekabpils | 26 | 2 | 24017 | 0,220 | 2 |
| | 3. | Aizkraukle | 12 | 3 | 7667 | 0,070 | 5 |
| | 4. | Bauska | 6 | 5 | 9250 | 0,085 | 4 |
| | 5. | Dobele | 8 | 4 | 10071 | 0,092 | 3 |

# Distribution diagram of planning regions of Latvia in plane of population number, "City rank after its weight" with direct linear regression, 2012



# Calculation of standardized coefficients for the assessment of polycentric development in planning regions of Latvia (base of 30 cities) 2012

| Region | Equation of log-linear regression (1) after area | Equation of log-linear regression (2) after weight | Standardized coefficient PM (1) | Standardized coefficient PM (2) |
|---|---|---|---|---|
| Kurzeme | *Ln(p)=-1,375*Ln(a)+11,247* | *Ln(p)=-1,135*Ln(w)+11,247* | -0,962 | -0,962 |
| Latgale | *Ln(p)=-1,578*Ln(a)+11,325* | *Ln(p)=-1,189*Ln(w)+11,189* | -0,971 | -0,949 |
| Riga | *Ln(p)=-2,240*Ln(a)+12,815* | *Ln(p)=-2,375*Ln(w)+12,996* | -0,911 | -0,978 |
| Vidzeme | *Ln(p)=-602*Ln(a)+9,840* | *Ln(p)=-813*Ln(w)+10,121* | -0,717 | -0,972 |
| Zemgale | *Ln(p)=-1,239*Ln(a)+10,858* | *Ln(p)=-1,313*Ln(w)+10,929* | -0,928 | -0,983 |

# Polycentric development level - functional prospective

Methods and guidelines:

- N. Limtanakool, M. Dijst and T. Schwanen (2007)
- P.Veneri and D. Burgalassi (2010)
- "Entropy index"

$$EI = -\sum_{i=1}^{L} \frac{(Z_i)\ln(Z_i)}{\ln(L)}$$

where:

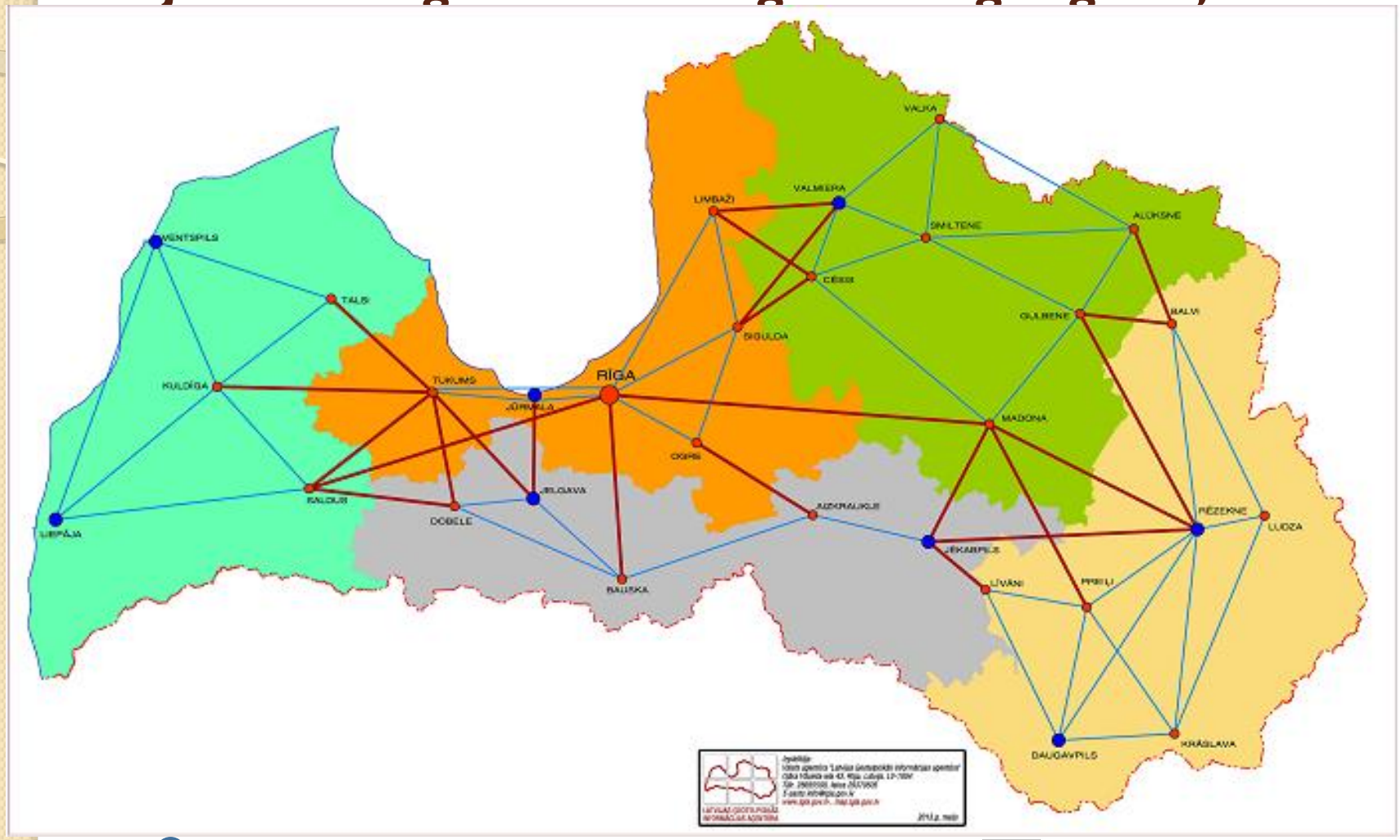
*L* - *links in the network*

*Zi* - *the proportion of journeys in link l in relation to the total number of journeys in the network.*

# Assessment method stages for functional polycentric development level

| Stage No. | Title of the stage | Result |
|---|---|---|
| 1. | **Identification of research subjects** | List of 30 cities (development centres of international, national, regional significance) within planning regions and after their jurisdiction |
| 2. | **Identification of road network existent among cities** | Cartographic material: "Functional joints among cities of Latvia in regional level, functional joints of regions with neighbouring regions" |
| 3. | **Determination of traffic intensity among research cities in plane of regions (country)** | Record lists of average daily traffic per year, the base workpieces of mathematical calculations |
| 4. | **Mathematical calculations of "Entropy index"** | - Identified nodes of functional centres in region<br>- Defined coefficient of functional prospective polycentric development level for regions |

# Functional joints among cities of Latvia in regional level, functional joints of regions with neighbouring regions, 2012




**Development centre of national significance**

**Development centre of national significance**

**Development centre of regional significance**

Functional connections among cities within region

Functional connections with neighbouring planning regions

Zemgale planning region

Riga planning region

Kurzeme planning region

Vidzeme planning region

Latgale planning region

# Indicators of polycentric development level within functional prospective in Latvia, 2012

| No. | Region | Node of the main region | Calculation result of "Entropy index" |
|---|---|---|---|
| 1. | Kurzeme | Liepaja | 0,994 |
| 2. | Latgale | Daugavpils | 0,995 |
| 3. | Riga | Riga | 0,964 |
| 4. | Vidzeme | Valmiera | 0,876 |
| 5. | Zemgale | Jelgava | 0,979 |

*Example: Traffic intensity indicators and calculation of "Entropy index" for Kurzeme planning region, 2012*

| *Cities and towns in Kurzeme region* | **Traffic intensity** | | | | | Calculation result of entropy index |
|---|---|---|---|---|---|---|
| | **Liepaja** | Kuldiga | Saldus | Talsi | **Ventspils** | |
| **Liepaja** | | 1953 | 3718 | 0 | 1438 | -0,33 |
| Kuldiga | 1953 | | 2321 | 2290 | 1957 | -0,35 |
| Saldus | 3718 | 2321 | | 0 | 0 | -0,31 |
| Talsi | 0 | 2290 | 0 | | 3396 | -0,30 |
| **Ventspils** | 1438 | 1957 | 0 | 3396 | | -0,32 |
| | | | | | Expressed coefficient | **-0,994** |

# Summary of acquired empirical results

| No. | Peak of the main region (title of the city) | Title of the region | City weight (9 cities in country scale) | City weight (R) (30 cities in regional scale) | Standardized coefficient | | Indicator of "Enthropy index" |
|---|---|---|---|---|---|---|---|
| | | | | | PM(1) (rank by area) | PM(2) (rank by weight) | |
| 1. | Liepaja | Kurzeme | *0,072* | *0,516* | **0,962** | **0,962** | **0,994** |
| 2. | Daugavpils | Latgale | *0,088* | *0,563* | **0,971** | **0,949** | **0,955** |
| 3. | Riga | Riga | *0,623* | *0,853* | **0,911** | **0,978** | **0,876** |
| 4. | Valmiera | Vidzeme | *0,024* | *0,327* | **0,717** | **0,972** | **0,964** |
| 5. | Jelgava | Zemgale | *0,056* | *0,533* | **0,928** | **0,983** | **0,979** |

# SUMMARY OF THE THESIS FOR OBTAINING THE DOCTORAL DEGREE IN ECONOMICS

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