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# The role of the manufacturing industry in shaping the economic base and functions of urban settlements in Łódzkie Voivodeship (Poland)

**Abstract:** This research deals with the presence and potential of the manufacturing industry in the urban settlements of Łódzkie Voivodeship. Its cognitive goal is to recognise the present share of industry in the economic and functional base of those settlements that, as a result of the system transformation, underwent restructuring and deindustrialisation, and the shrinking of its economic base. The re-development of this base and functions, appropriate to the role of towns and cities in the settlement system, requires new paths and indicating them is the application objective of the research. The work is based on the theory of the economic base of settlements, using statistical and cartographic methods including 'heat maps' as well as 'employment surplus' and the Amemiya indicator. Studies have shown that both economic and industrial potential are concentrated in the urban settlements of the Łódź agglomeration but decrease especially towards the south and south-east, and that traditional sectors still dominate. Despite intensive deindustrialisation, industry still plays a significant role in the economic base and functions of most small and medium towns of the voivodeship, as well as parts of some large urban settlements. Further economic development, and the role in it of small and medium towns depends on their further industrialisation or re-industrialisation, while of large and medium urban centres – on knowledge-based services.

**Keywords:** economic structure and functions of settlements, functional hierarchy of settlements, industry, Łódzkie Voivodeship, Lódź region, urban economic base

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## Introduction

The basis of regional development is the socio-economic potential concentrated in urban settlements whose size and characteristics shape the functional and spatial structure of the settlement system, including regional spatial systems. At lower levels of the

settlement hierarchy, with no foundation for the development of services, as in large settlements, the manufacturing industry is of particular importance. In Poland today, spatial disparities in its distribution and thus the level of socio-economic development result from historical conditions, changes resulting from the system transformation after 1989, and from contemporary global trends in the development of the manufacturing industry. This industry is undergoing constant restructuring and modernisation, including a reduction in employment which, together with new investments, has contributed to an increase in productivity and competitiveness in Poland. As a result, the share in the employment of industry and the activation of the population on the labour market has decreased (Rachwał, Wiedermann, Kilar 2008a, 2008b). At the same time, the relocation of industrial production from central city areas to their surroundings is observed.

While the core cities of the largest agglomerations in Poland began to rebuild their economic base relatively quickly after the transformation shock, in peripherally located urban settlements, especially small and medium ones, processes of depopulation and a loss of economic base have been observed (Bartosiewicz, Pielesiak, 2010; Dej, 2016; Domański, 2001, 2008; Gorzelak, Smętkowski, 2005; Krzysztofik et al., 2016; Krzysztofik, Szmytkie, 2018; Kwiatek-Sołtys et al., 2014; Smętkowski, Jałowiecki, Gorzelak, 2008; Sokołowski, 2008; Stryjakiewicz, 1999; Śleszyński 2007, 2017; Śleszyński et al., 2019; Śleszyński, Wiedermann 2020; Wiedermann, 2015). It is therefore necessary to search for new development paths, using internal competitive advantages and potential. Such processes often require public intervention, but only in this way will it be possible to shape two-way functional connections in a core-periphery system. Industry can play a special role in these processes because in terms of the economic base it creates, together with higher-order services, a core of mainly specialised exogenous functions (Rykiel, 1991). This applies mostly to large plants producing for supra-local markets.

The role of the manufacturing industry is, therefore, critical from the perspective of local development in small and medium towns. This development means the growth of the local economy due to a constant inflow of capital from outside, employment, tax revenue as well as numerous multiplier effects (Domański, 2001; Domański, Gwosdz, 2005; Wiedermann, 2016). The benefits are also significantly higher than just a surplus in the balance of funds passing through the company if it is included in a global value chain (Gereffi 1996, 1999; Gereffi et al., 2001). In this aspect, the level of innovation in production is particularly important as it enables enterprises to be included in these global chains and contributes to the development of knowledge-based services through demand for product or technological innovation. It is also vital for the enterprise to be rooted locally, limiting or eliminating the problem of profit transfers to parent companies located outside the country (Shapiro, Sarin, 2008; Stiglitz, 2006).

In terms of the economic base of urban settlements (Dziewoński, Jerczyński, 1971; Suliborski, 2010) and the concept of the socio-economic region (Dziewoński, 1967; Rykiel, 1991, 2001), a hierarchical settlement system is formed, influencing functional relations and shaped by the exogenous functions of towns and cities. After 1990, during the system transformation, many urban settlements were affected by the restructuring of the economy, especially the manufacturing industry. As a result, on the one hand, standards and production efficiency were adapted to the requirements of a market economy. However, at the same time, in many towns and cities, employment was

significantly reduced, and an economic recession and shrinking of the economic base took place, produced by cutting the share of exogenous functions including specialised ones.

From a local and regional development perspective, these processes were particularly visible in areas where economic potential based on the traditional, labour-intensive industry was found (Chojnicki, 1990; Parysek, 1992a, 1992b; Stryjakiewicz, 1999). An example of such a region was Łódzkie Voivodeship in which the significant production potential of traditional industry, including the textile industry, was concentrated in several towns and cities making them monofunctional settlements. In these (e.g. in Łódź, Piotrków Trybunalski, Tomaszów Mazowiecki and Sieradz) many industrial plants were closed as a result of the transformation processes (Bartosiewicz, Marszał, 2011; Knapik, 2010; Lamprecht, 2011; Marczyńska-Witczak, 2001; Marczyńska-Witczak, Piech 1998; Marszał, May, 2002, Matczak, 2011, Suliborski, 1992, 2000, 2001, 2002; Suliborski, Walkiewicz, Wójcik, 2009).

As many authors indicate (incl. Hudson, 1994; Krzysztofik et al., 2015; Mills, Hamilton, 1984: Riley, Tkocz, 1998: Tkocz, 2001) the restructuring of areas such as Łódzkie Voivodeship is long-lasting and consists mainly of the closure of most existing production resources and replacing them with new production sectors of an export nature (Kłosowski, 2006; Tkocz, 2006). After three decades of change, however, many settlements in the voivodeship are still in danger of decline. Studies of functional changes in the decade 2004–2014 showed (Śleszyński, 2017) that out of 17 medium towns in Łódzkie Voivodeship, five were at risk of marginalisation (Kutno, Ozorków, Radomsko, Wieruszów, Zduńska Wola), while another two were examples of decreasing potential (Sieradz, Tomaszów Mazowiecki).

Considering the problems outlined above, the authors set themselves two goals:

1. cognitive – identifying the importance of industry in shaping the role of urban settlements in Łódzkie Voivodeship,
2. application – pointing out to local government at various levels, activities to shape a model of a balanced functional and spatial structure in the voivodeship's settlement system.

The implementation of the above objectives required four sub-objectives:

- recognising the share of industry in the economy of urban settlements in Łódzkie Voivodeship,
- understanding the division and spatial structure of industry in the urban settlements of the voivodeship,
- recognising industry's share in the economic base and functions of the voivodship's urban settlements,
- indicating the potential role of towns and cities in the functional and spatial structure of the voivodeship's settlement system.

The spatial scope of research covered 44 urban settlements of Łódzkie Voivodeship (as of 2017) within their administrative boundaries, i.e. urban gminas (communes) and rural-urban gminas. For 2017, the analysis considered entrepreneurship potential and industry participation; for 2014, regarding the share of specific industrial sectors of entities by size. Analyses of the economic base and functions of urban settlements, with particular emphasis on the role of industry, were carried out for 2016, treating them as a result of changes in economic potential and its pattern. Empirical research was based on quantitative statistical and cartographic methods, using data from the Local Data

Bank of the Central Statistical Office of Poland and unpublished data from gminas on employment numbers.

The measure of economic potential and its pattern, including manufacturing, was the number of economic entities by the divisions of section C (according to the Polish Classification of Activities – PKD 2007). Such analysis allowed the basic features of the economic structure to be determined. For simplification (section C), manufacturing industries were combined into aggregates, taking into account the nature of their knowledge requirements according to the CSO classification (GUS, 2019). In the case of employment estimates, data calculated for the needs of the project on the functional relations of urban settlements in six Polish voivodeships, including Łódzkie (Śleszyński et al., 2019; Śleszyński, Wiedermann, 2020) were used. It resulted from the fact that for gminas there is no reliable data on the number and type of employees according to PKD divisions. Estimates were based, among others, on data for the number of employees by poviat developed by the tax office in Bydgoszcz and the Statistical Research and Education Center of the Central Statistical Office in Jachranka in 2016–2017[1], on the number of enterprises in gminas (Local Data Bank of the CSO), commuting in 2016 by the Urban Statistical Center in Poznań[2], and other data.

A complex problem was an analysis of the economic base and functions of urban settlements and in particular the selection of an appropriate measure. In research to date, such a measure was usually the number of employees in particular sectors of the economy. A formula (Dziewoński, Jerczyński, 1971; Jerczyński, 1973; Suliborski, 2010) was used to measure the size of the exogenous component, i.e. the employment surplus, which is based on the location quotient (LQ) of Florence (Isard, Bramhall, 1965), assuming that such a surplus arises when $LQ \geq 1$.

This above indirect method is a classic technique for measuring the economic base used in comparative geographic and economic studies of a large number of urban settlements. It enables an analysis of their functional diversity (more recent works include Bogdański, 2019; Kłosowski, 2003; Kubejko-Polańska, 2013; Matczak and Szymańska, 2000; Sokołowski, 2008; Suliborski, 2010; Wójcik, 2010; Zarówna, 2017; see also a review of older research for Łódzkie Voivodeship: Walkiewicz, 2010). The advantage of this method is the ease of interpretation with a relatively advanced calculation procedure. The essence of the employment surplus index consists of comparing the economy of a given town or city, according to the number of employees, with a reference area adopted as a standard.

It should be noted, however, that the employment surplus is only one component of the measure of success in the economy of a given town or city and does not exhaust measurement of the entire level of local development (Sokołowski, 2008). It is mainly due to the construction of the indicator which is a relative measure relating the degree of development of a given town or city to an average level in a reference system, usually the entire country. The specialisation of local economies most often differs from the overall average, hence demand on the labour market or the level of unemployment, may indicate different needs. The employment surplus in large urban complexes is

[1] https://stat.gov.pl/statystyki-eksperymentalne/kapital-ludzki/opracowanie-metodologii-i-oszacowanie-liczby-pracujacych-w-gospodarce-narodowej-wedlug-glownego-miejsca-pracy-i-miejsca-zamieszkania-na-poziomie-powiatow-stopy-bezrobocia-rejestrowanego-na-poziomie-,5,1.html.

[2] https://stat.gov.pl/obszary-tematyczne/rynek-pracy/opracowania/przeplywy-ludnosci-zwiazane-z-zatrudnieniem-w-2016-r-,20,1.html.

also natural due to the high level of concentration of economic entities. Therefore, to correctly conclude a level of economic development, a comparative analysis should be made between settlements of a similar size category (Pownall, 1953).

The indicator of Amemiya (1963) was used to assess the degree of diversification of the economic base and functions of urban settlements. The value of the indicator is between 0 and 1, but if it is calculated to two decimal places, it can be multiplied by 100 to obtain better clarity, i.e. the values are in the range 0–100. A value of 0 means a fully diversified, multifunctional structure (the same number of employees in each of the analysed activities) and 100 – monofunctionality (all working in one type of activity). The increase in value, therefore, means an increase in the specialisation of the economy of an urban settlement.

## Manufacturing industry and the economic potential of urban settlements

In 2017, the economic potential of the urban settlements of Łódzkie Voivodeship comprised 181 113 businesses, of which 93 448 were located in Łódź (51%), 53 798 and 20 596 in large and medium towns, 8903 in small towns, and 368 in very small towns. The number of economic entities was thus clearly correlated with the population of urban settlements (Figure 1). It should also be noted that these numbers, since 2009 and the most negative effects of the economic crisis, have changed irregularly and differently in settlements of different sizes. In 2009–2015, in Łódź and settlements of over 15 000 inhabitants, this process was variable. The increase in numbers was highest in Łódź, although observed only since 2015. In towns of fewer than 15 000, this increase was systematic since 2009. In towns of fewer than 5 000, there was no decline in entrepreneurship during the economic crisis. As a result, the growth of businesses was highest in Łódź and very small towns (May, 2020).

The concentration of businesses per 1000 inhabitants of the voivodeship's urban settlements was 116,59 in 2017 and had increased by 13% since 2009. This increase, however, was less correlated to the size of settlements and was more dynamic than the increase in the number of economic entities (May, 2020). Small and very small towns, except for Pajęczno, Poddębice, Rzgów, Tuszyn, Uniejów and Wieruszów, had a low (<100,0) or medium (110,0–100,0) level of entrepreneurship. Among large urban settlements, on the other hand, a low level of concentration was found in Bełchatów, Kutno, Tomaszów Mazowiecki and Radomsko, and in the remaining six it was average. Average and low levels of business concentration were also observed in the majority of medium towns, except Aleksandrów Łódzki, Konstantynów Łódzki, Łask, Rawa Mazowiecka and Wieluń, where this level was higher than 110,0 (Figure 1).

These figures indicate a relatively small economic base and level of exogenous functions in large urban settlements and in most medium ones, which makes it difficult for them to play the role of sub-regional and supra-local centres in the voivodeship's settlement system. In the voivodeship, two areas with a high concentration of economic entities can be distinguished: (1) the Łódź agglomeration and the southern and south-western border of the voivodeship, and (2) south-eastern and northern areas which are peripheral in this respect. The average level of entrepreneurship concentration in large and medium urban settlements to the south and south-west of Łódź could have been the result of the 'leaching' of development factors from the Łódź

agglomeration and in towns on the north-eastern border from both Łódź and Warsaw agglomerations (Figure 1).

Among economic entities, in 2017, regardless of the size of the urban settlement, the most critical role was played by trade, manufacturing industry and construction. Their share in total exceeded 50% in very small, small and medium towns, and if combined with professional, scientific and technical activities, in large towns and Łódź. Significant sections included services such as health care, transport and storage, and in Łódź, real estate services as well. The share of these ranged from approx. 8% to approx. 2,5% and the differentiation was most significant in Łódź and large towns while lowest in small towns.

It should also be noted that the importance of trade, industry and construction in the entrepreneurship of the voivodeship settlements has been decreasing since the beginning of the system transformation (Marczyńska-Witczak, 2001; Marczyńska-Witczak, Piech, 1998; Marszał, May, 2002; Walkiewicz, 2001) in favour of public and knowledge-based services: healthcare, professional, scientific and technical activities, information and telecommunications as well as real estate and business services. The declining importance of the manufacturing industry was most considerable in Łódź and small towns, and lowest in large and very small towns (Figure 2).

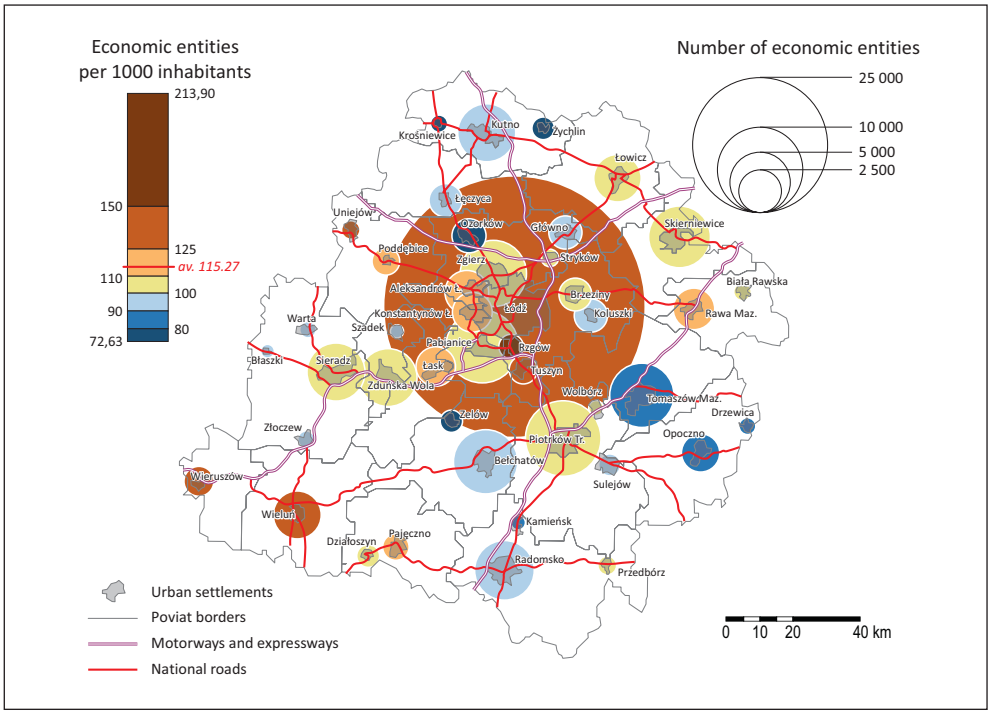
The share of industry in small businesses (<50 employees) in the urban settlements of Łódzkie Voivodeship was almost identical to that observed for businesses in general, both in the entire population (approx. 11%) and in all sizes of urban settlements. The same was also true for small industrial entities (Figure 3). This situation resulted from the dominant share of small businesses not only among entities in general (99%) but also among those in section C – manufacturing industry (97,5%).

Medium businesses (50 to 249 employees) had a much smaller share: only 0,9% of the total number of economic entities and 2,2% among industrial entities. It should be remembered that in 2014 in the 44 urban settlements of the voivodeship there were 400 medium manufacturing entities, of which 193 were in Łódź. In large cities there were from 18 to four such entities, in medium towns from 11 to two, and generally below five in smaller towns.

Despite the above variations in deindustrialisation, the size groups of voivodeship urban settlements and Łódź itself showed a similar share of the manufacturing industry in the total number of economic entities. In 2014, these ranged from approx. 12% in medium and small towns to approx. 10,5% in large towns and Łódź (Figure 3). In 2017 they were by approx. 1 pp. higher in large and very small urban settlements. Thus, the share of industry decreased with the size of the settlement. The lack of consistency of this phenomenon with deindustrialisation was the result of its proportional dependence on the share of industry in the economy of settlement size groups at the end of the system transformation (Figure 2).

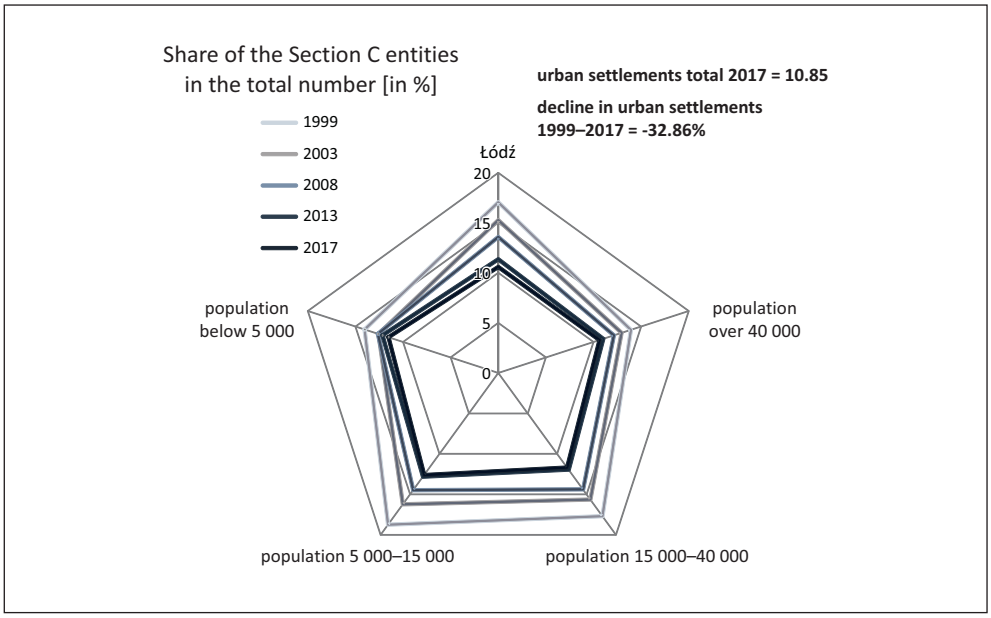
It should be noted that the settlements of specific size groups were not uniform in terms of the proportions discussed. In 2014 they ranged from approx. 6% to 15% in very small towns, 18% in small towns, 17% in medium and 15% in large. Regardless of the settlement size, higher shares were also characteristic of Łódź and the towns of the Łódź agglomeration, ranging from 11% to 18%. The exception was Aleksandrów Łódzki, where they were just under 24%. Larger shares, in the range of 10% to 14%, were also observed in some former industrial settlements west and south of Łódź at Zduńska Wola, Łask, Radomsko and Tomaszów Mazowiecki, as well as in most very small and small towns in southern and western parts of the voivodeship. Towns in the northern and eastern parts of the voivodeship had a low level of industrialisation (Figure 3).

*Figure 1.* Economic potential of the urban settlements of Łódzkie Voivodeship in 2017



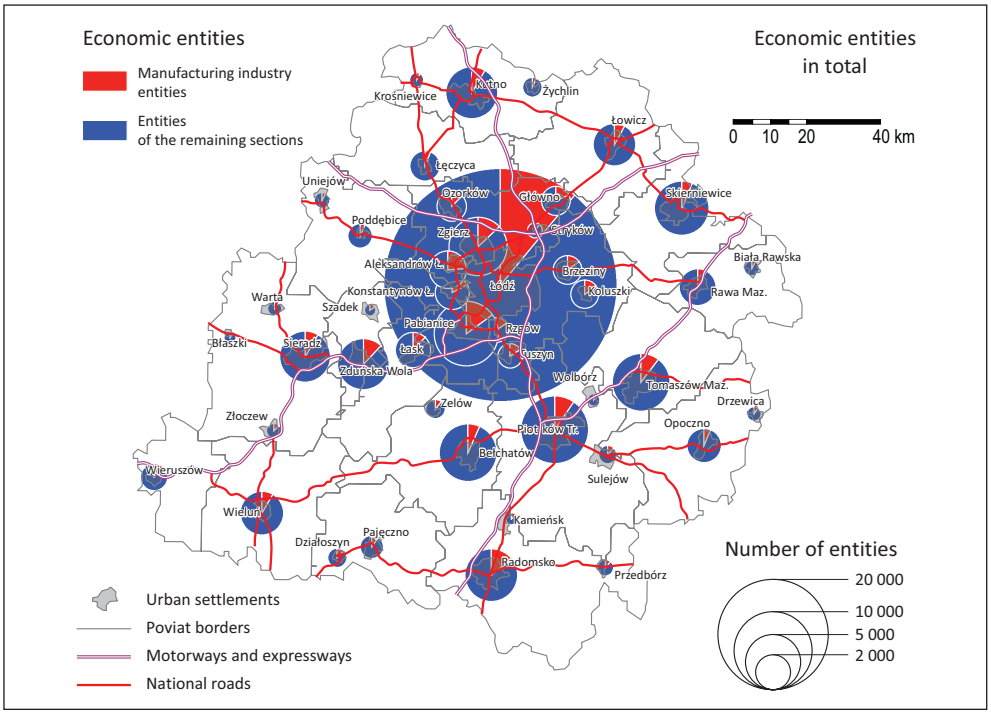

Source: authors based on BDL CSO data

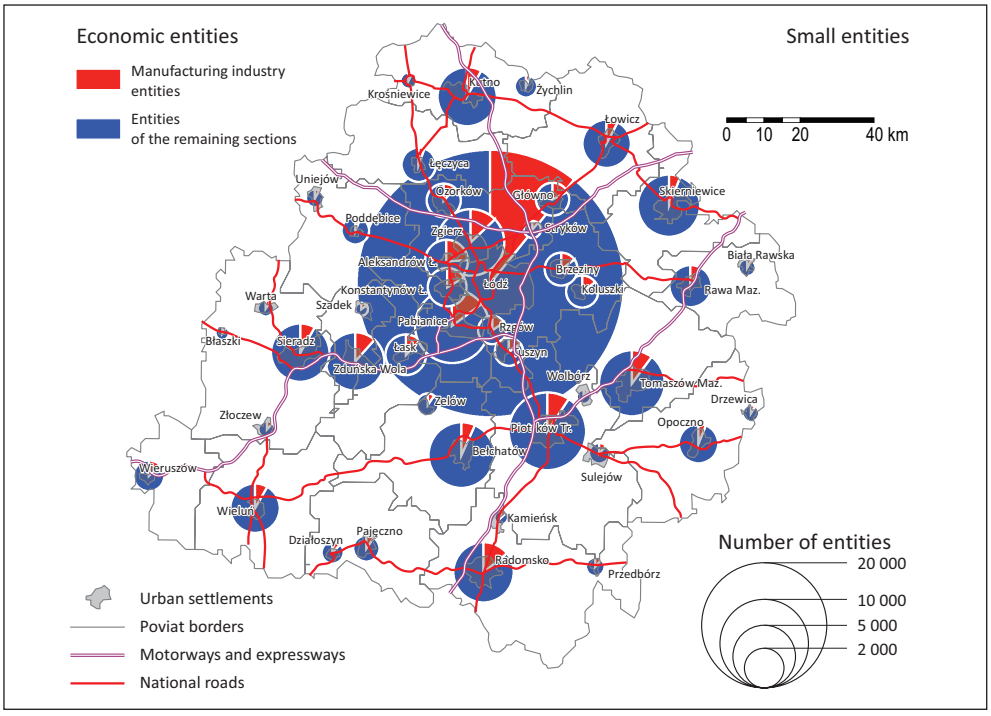
*Figure 2.* Changes in the importance of manufacturing industry in the economy of urban settlements in Łódzkie Voivodeship by size: 1999–2017

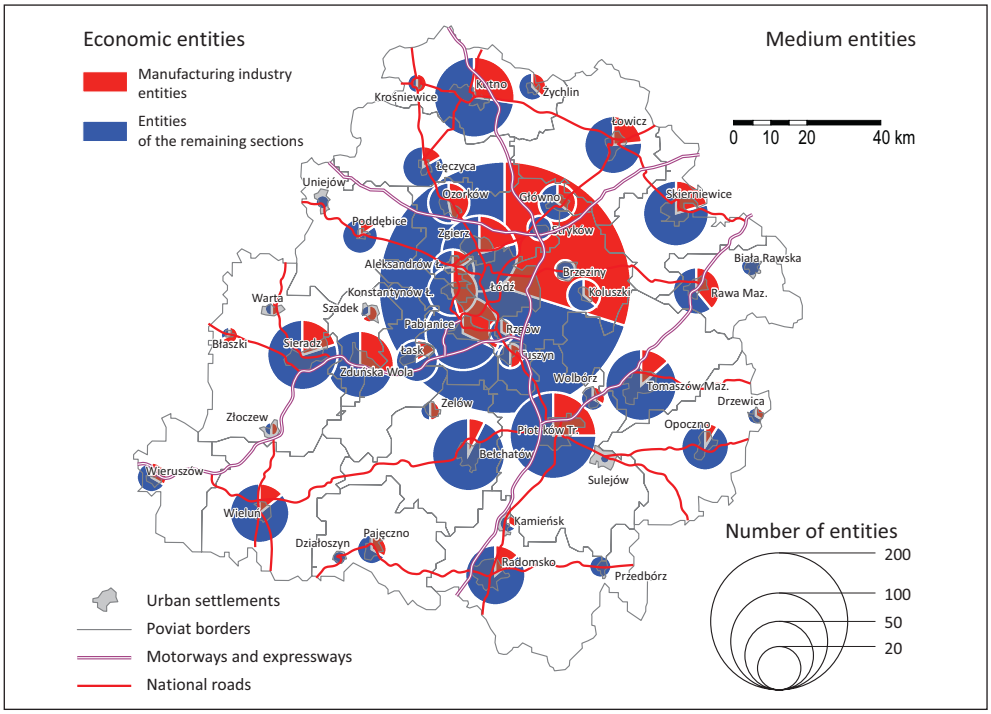


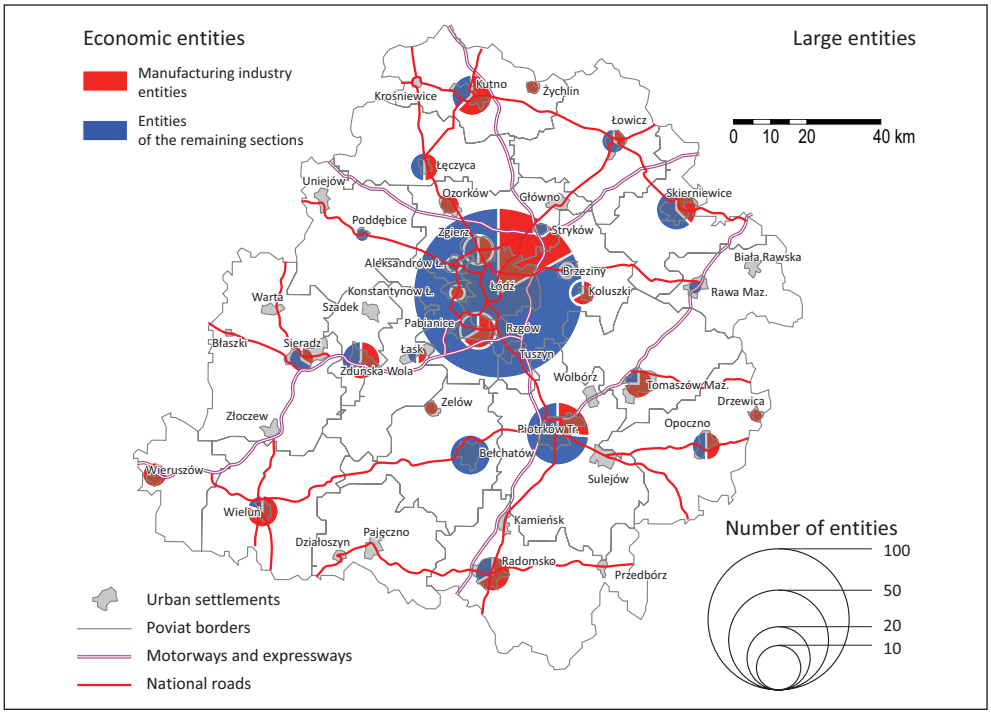

Source: authors based on BDL CSO data

*Figure 3.* The share of the manufacturing industry in the number of economic entities in urban settlements of Łódzkie Voivodeship in 2014, by entity size






Source: authors based on unpublished CSO data

However, the share of industry in entrepreneurship was much more significant than among small settlements and generally increased along with the decreasing size of the settlement and the total number of medium businesses. In the largest settlements, these shares ranged from approx. 30% in Łódź, Pabianice and Zduńska Wola to approx. 13% in Radomsko and Tomaszów Mazowiecki and 7% in Bełchatów. Medium centres were very variable in this respect, and the observed shares of industry in medium settlements ranged from over 45% in Konstantynów Łódzki and Ozorków to over 13% in Wieluń and Łask, and approx. 9% in Opoczno. In small and very small towns, on the other hand, a small number of industrial plants accounted for from 30% to even 66% of the total number. However, in Łęczyca and Poddębice, these figures were lower than 17%, and in six towns of this size, no medium industrial entity was located (Figure 3).

The number of entities employing 250 or more people, i.e. large ones, was the smallest. In 2014, there were 73 such industrial entities located in only 22 towns of the voivodeship which constituted 0,4% of industrial entities and 31,6% of the total number of large entities. Such entities were located in Łódź (21) and all large towns, except Bełchatów, from five in Pabianice and Kutno to one in Sieradz, and 1–2 each in six medium, five in small and one in very small towns. The exception was Wieluń, where four large industrial entities were located. Their share in the total number of large enterprises was generally higher than 50% due to the small number of such enterprises. Smaller shares of industrial entities in the number of large ones were found only in Łódź (17%), Piotrków Trybunalski (26%) and Sieradz (33%) (Figure 3).

In the spatial structure of the voivodship's urban settlement system, the analysis of the concentration of medium and large industrial entities confirmed the importance of the Łódź agglomeration and the southern area of the voivodeship, resulting from the analysis of small entities. A higher concentration of medium and large industrial entities was also characteristic of urban settlements in the northern and north-eastern part of the voivodeship and towns of equal size located west of the Łódź agglomeration, as well as Piotrków Trybunalski. However, the role of industry in the economic structure of towns in the south-eastern and north-western areas of the voivodeship was insignificant (Figure 3).

## Divisional structure of industry

The divisional structure of industrial entities, in general, was very similar to that of small entities. Over 52% is light industry, with clothing and textiles (approx. 38%), and the rest are mainly in repair and installation of machinery and equipment. The following industries had smaller but significant shares: metal and metallurgy (>9%) and food (>7%), as well as wood and paper, printing, rubber and plastics, mineral and building materials and furniture (from 6% to 4%). Relatively small proportions were recorded for high and medium technology industries: chemical and pharmaceutical as well as electronic and optical (<2%), electrical engineering and machinery (<4%) (Figure 4).

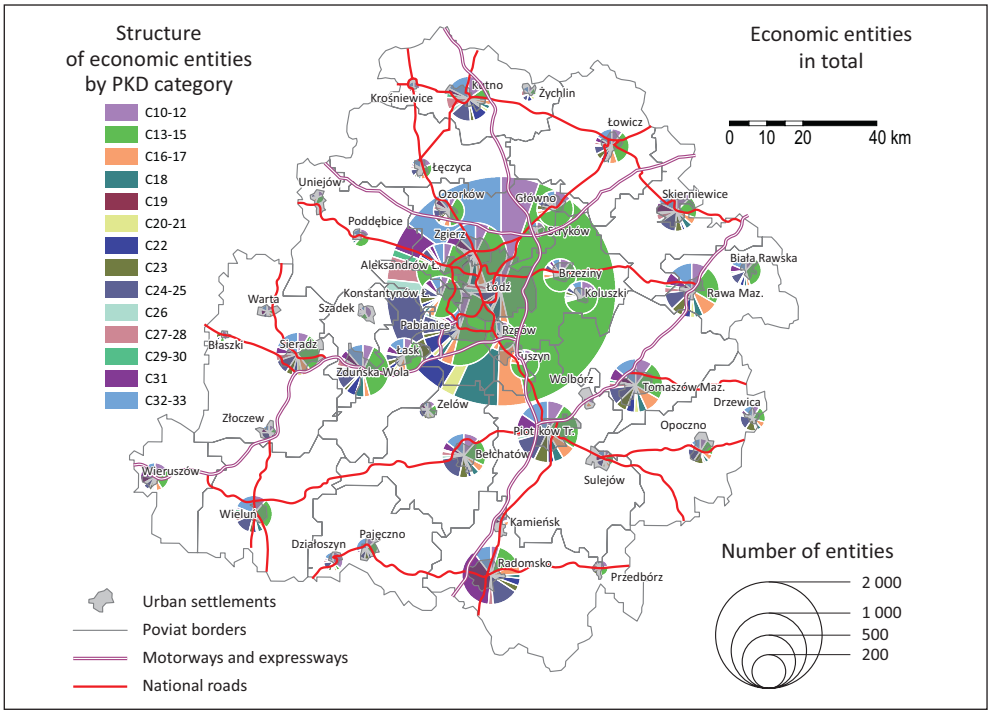
The divisional structure for all small industrial entities in the settlements of the Łódź agglomeration, regardless of size, and Zduńska Wola, Poddębice and Uniejów were also very similar to the above pattern. In these settlements, structural inertia in terms of clothing and textile activities was found, especially in Aleksandrów Łódzki and in small and very small towns of the Łódź agglomeration, as well as in food processing in Głowno, Poddębice and Uniejów.

In other urban settlements, the share of clothing and textiles, among small industrial entities and industrial entities in total, was lower and ranged from 35% to 20% in most medium and small towns, and from 20% to 10% in large and very small ones. On the other hand, the share of food processing was 10% to 40%, increasing inversely to the size of the settlement. In towns with a smaller share of food or textile and clothing industries, the greater importance of metal and metallurgical industries was found, with wood and paper, mineral and construction materials in very small towns, electrical engineering and machinery in large, medium and small towns and furniture in large, medium and very small towns (Figure 4 and 5).

Moreover, in some urban settlements, mainly small and very small ones, as well as in Bełchatów, Kutno, Radomsko, Zgierz, Rawa Mazowiecka and Łask, a specific type of industrial specialisation was found among small industrial entities and entities in general. It should be noted, however, that the urban settlements of the voivodeship had relatively similar and poorly diversified divisional structures in terms of small industrial entities, regardless of the share of individual sectors in specific urban settlements (Figure 4 and 5).

Compared to small entities, in the divisional structure of medium industrial entities, the share of the textile and clothing industry was smaller (approx. 30%), while food processing was twice as large (approx. 16%). These divisions, together with the rubber and plastics industries, had a 57% share and the following were also significant: wood and paper (6%), metal (9%), as well as electrical engineering and

*Figure 4.* The divisional structure of industrial entities in urban settlements of Łódzkie Voivodeship in 2014
*Łódzkie Voivodeship* in 2014, by entity size




Source: authors based on unpublished CSO data

machinery (7%). Apart from the latter, the chemical and pharmaceutical industries (3%) had a relatively large share among the high and medium technology industries (Figure 6).

Only Łódź had a structure similar to this pattern. In other towns, significant differences in this respect were found. Such a situation was due to the relatively small number of medium industrial entities which decreased with the size of urban settlements. As a result, there was an absence in many sectors of industry. None of the large settlements recorded all industrial sectors. The transport industry was located only in Pabianice, Skierniewice and Kutno, mineral and construction materials in Kutno, Zduńska Wola and Piotrków Trybunalski, 'other types' in Piotrków Trybunalski, Bełchatów and Zduńska Wola, and metal in Zgierz, Skierniewice, Piotrków Trybunalski and Radomsko. Medium chemical plants were located only in Kutno, electronics and optics in Bełchatów and furniture in Tomaszów Mazowiecki. On the other hand, there were no medium entities of the coke and chemical industry in any of the large settlements (Figure 6).

In the divisional structure of medium industrial entities in most large settlements, the most important was either the textile and clothing industry which ranged from > 40% in Zgierz, Sieradz, Pabianice and Tomaszów Mazowiecki to <37% in Kutno, Radomsko, Zduńska Wola and Piotrków Trybunalski or food processing (from 11% to 50%) in Piotrków Trybunalski, Bełchatów, Skierniewice, Kutno, Zduńska Wola and Sieradz (Figure 6).

In most medium urban settlements, medium entities from the textile and clothing industry (from 55% to 33%) and food processing (from 67% to 13%) were also numerous. Medium entities of the clothing and textile industry were not located in Opoczno or Łask, and food processing was not recorded in Opoczno, Aleksandrów Łódzki or Konstantynów Łódzki. The remaining manufacturing industries were not represented in medium urban settlements or were represented very poorly. Similar relationships were observed in small towns, but there were less textile and clothing industry and food processing, in 8 and 10 respectively out of the 18 towns (Figure 6).

The divisional structure of large industrial entities at the level of the entire population was relatively diversified, with the absence of the coke industry and the shares of others ranging from 15% to 14% in the clothing and textile, and metal and food processing industries, to 1,4% in the printing and wood and paper industries. However, as mentioned above, large industrial plants were few and located only in some urban settlements, mainly large and medium ones. Moreover, in none of the urban settlements, even Łódź, was the full industrial structure represented. However, Łódź showed the most diverse structure of large industrial entities. The electrotechnical and machinery industries had the largest share, followed by textiles and clothing, metal, food, other, printing, construction materials, electronics and optics. In other towns of various sizes, some industrial sectors were represented by single large enterprises, most often for food processing and textile and clothing industries. In the case of large industrial entities, it is difficult to indicate specialisations because a large proportion can result from a minimal number of entities (Figure 7).

The reasons for such a small number of large and medium industrial entities are complex. The most important probably include a low level of local investment capital, as evidenced by numerous strategic and planning analyses of the region, e.g. *Koncepcja Strategii*..., *2014; Strategia*..., *2013;*, *Strategia*..., 2020, and the low attractiveness of

*Figure 5.* Divisional structure of small industrial entities in the urban settlements of Łódzkie Voivodeship in 2014

| Urban settlement | Population ('000) | C10–C12 | C13–C15 | C16–C17 | C18 | C19 | C20–C21 | C22 | C23 | C24–C25 | C26 | C27–C28 | C29–C30 | C31 | C32–C33 | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Łódź | 706.0 | 81 | 123 | 97 | 153 | 174 | 129 | 115 | 93 | 97 | 147 | 115 | 123 | 77 | 122 | 114 |
| Piotrków Trybunalski | 75.6 | 91 | 49 | 123 | 77 | | 40 | 56 | 155 | 106 | 66 | 89 | | 115 | 83 | 76 |
| Pabianice | 67.2 | 85 | 158 | 128 | 72 | | 114 | 209 | 66 | 108 | 97 | 80 | 29 | 85 | 107 | 124 |
| Tomaszów Mazowiecki | 64.5 | 96 | 43 | 145 | 72 | | 110 | 85 | 129 | 80 | 23 | 74 | 123 | 93 | 69 | 71 |
| Bełchatów | 59.3 | 76 | 28 | 63 | 50 | | 34 | 34 | 91 | 105 | 59 | 52 | 67 | 53 | 51 | 51 |
| Zgierz | 57.4 | 103 | 100 | 85 | 94 | | 195 | 117 | 94 | 115 | 183 | 69 | 69 | 117 | 97 | 104 |
| Skierniewice | 48.7 | 85 | 25 | 65 | 61 | | 31 | 13 | 80 | 76 | 51 | 75 | 61 | 74 | 64 | 50 |
| Radomsko | 47.4 | 66 | 39 | 146 | 51 | | 21 | 107 | 103 | 165 | 53 | 89 | 84 | 714 | 81 | 111 |
| Kutno | 45.4 | 117 | 19 | 49 | 45 | | 79 | 157 | 49 | 110 | 121 | 168 | 196 | 43 | 84 | 64 |
| Zduńska Wola | 43.3 | 84 | 98 | 73 | 112 | 406 | 35 | 122 | 51 | 137 | 104 | 143 | 91 | 86 | 75 | 96 |
| Sieradz | 43.1 | 76 | 52 | 104 | 4 | | 130 | 61 | 97 | 79 | 23 | 98 | | 66 | 94 | 67 |
| Łowicz | 29.2 | 83 | 56 | 102 | 38 | | 52 | 70 | 101 | 45 | 52 | 58 | 34 | 56 | 73 | 63 |
| Wieluń | 23.3 | 135 | 63 | 64 | 88 | 755 | 87 | 52 | 95 | 138 | 22 | 242 | 212 | 26 | 120 | 90 |
| Opoczno | 22.0 | 55 | 23 | 77 | 51 | | | 28 | 156 | 82 | | 38 | 45 | 41 | 43 | 43 |
| Aleksandrów Łódzki | 21.2 | 148 | 420 | 62 | 44 | | 48 | 105 | 46 | 89 | 71 | 93 | 93 | 85 | 94 | 215 |
| Ozorków | 20.1 | 60 | 76 | 102 | 28 | | 76 | 20 | 110 | 75 | | 98 | 99 | 82 | 53 | 69 |
| Łask | 17.9 | 115 | 119 | 219 | 42 | | 199 | 114 | 178 | 74 | 28 | 63 | | 125 | 122 | 115 |
| Konstantynów Łódzki | 17.9 | 122 | 185 | 188 | 84 | | 143 | 91 | 219 | 137 | 28 | 47 | 222 | 134 | 87 | 144 |
| Rawa Mazowiecka | 17.7 | 102 | 70 | 63 | 53 | | | 92 | 41 | 101 | 28 | 48 | 223 | 93 | 109 | 80 |
| Głowno | 14.8 | 287 | 191 | 89 | 38 | | | 28 | 166 | 89 | 102 | 115 | 402 | 20 | 80 | 137 |
| Łęczyca | 14.7 | 107 | 30 | 76 | 51 | | 35 | 14 | 50 | 51 | 34 | 58 | 68 | 31 | 59 | 46 |
| Koluszki | 13.4 | 263 | 173 | 42 | 42 | | 38 | 61 | 128 | 49 | 75 | 63 | | 22 | 88 | 119 |
| Brzeziny | 12.6 | 183 | 215 | 119 | 30 | | 162 | 16 | 58 | 75 | 80 | 45 | | 83 | 74 | 134 |
| Wieruszów | 8.7 | 322 | 86 | 194 | 43 | | 118 | 70 | 170 | 109 | 58 | 98 | | 553 | 94 | 139 |
| Żychlin | 8.5 | 43 | 19 | | 44 | | 179 | 119 | | 55 | 59 | 99 | | | 44 | 36 |
| Zelów | 7.8 | 140 | 36 | | | | 262 | 52 | 126 | 121 | 64 | 36 | 127 | 135 | 40 | 64 |
| Poddębice | 7.8 | 171 | 66 | 24 | 72 | | | 26 | 31 | 36 | | 36 | | 39 | 80 | 63 |
| Tuszyn | 7,3 | 199 | 298 | 204 | 26 | | 70 | 28 | 167 | 103 | 69 | 77 | 135 | 82 | 34 | 172 |
| Pajęczno | 6.8 | 143 | 72 | 27 | 28 | | | 120 | 216 | 97 | | 83 | 291 | 66 | 220 | 103 |
| Sulejów | 6.4 | 114 | 58 | 117 | | | | 64 | 115 | 133 | | | | 188 | 88 | 79 |
| Działoszyn | 6.1 | 493 | 15 | 91 | 61 | | 83 | 33 | 159 | 138 | | 138 | | 73 | 122 | 96 |
| Krośniewice | 4.5 | 162 | 5 | 42 | | | | | 109 | 63 | | 125 | | 67 | 69 | 43 |
| Drzewica | 4.0 | 122 | 12 | 47 | | | | 51 | 184 | 237 | | 71 | 497 | 75 | 31 | 62 |
| Przedbórz | 3.7 | 328 | 75 | 101 | 101 | | | 55 | 265 | 76 | | 381 | | 121 | 67 | 110 |
| Stryków | 3.5 | 240 | 72 | 211 | | | | 230 | 138 | 53 | | 80 | 280 | | 123 | 98 |
| Rzgów | 3.4 | 393 | 450 | 495 | 55 | | 450 | 899 | 289 | 472 | 148 | 249 | 292 | 44 | 239 | 378 |
| Złoczew | 3.4 | 143 | 41 | 111 | | | | 181 | 145 | 335 | | | | 177 | 111 | 102 |
| Warta | 3.3 | 218 | 21 | 168 | 112 | | | | | 113 | | | | 224 | 112 | 77 |
| Biała Rawska | 3.2 | 412 | 14 | 58 | 58 | | | 126 | 76 | 116 | | | | 185 | 38 | 76 |
| Uniejów | 3.1 | 238 | 83 | 184 | | | | 67 | 80 | 93 | | 185 | | 49 | 41 | 87 |
| Kamieńsk | 2.9 | 211 | 8 | 260 | | | | | 511 | 131 | | | | 208 | 108 | 89 |
| Wolbórz | 2.4 | 359 | 10 | 316 | | | 216 | | 104 | 160 | | | | 63 | 26 | 75 |
| Błaszki | 2.2 | 487 | 31 | 83 | | | | 181 | 437 | 42 | | | | | 28 | 83 |
| Szadek | 2.0 | 658 | 80 | 92 | | | | 201 | 121 | 47 | | | | 148 | 123 | 127 |

Source: authors based on unpublished CSO data

*Figure 6.* Divisional structure of medium industrial entities in the urban settlements of Łódzkie Voivodeship in 2014

| Urban settlement | Population ('000) | C10–C12 | C13–C15 | C16–C17 | C18 | C19 | C20–C21 | C22 | C23 | C24–C25 | C26 | C27–C28 | C29–C30 | C31 | C32–C33 | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Łódź | 706.0 | 81 | 104 | 107 | 120 | 224 | 138 | 115 | 82 | 115 | 187 | 112 | 128 | 100 | 145 | 108 |
| Piotrków Trybunalski | 75.6 | 65 | 117 | 91 | 419 | | | | 190 | 180 | | | | | 246 | 99 |
| Pabianice | 67.2 | | 151 | 307 | 157 | | | 242 | | | | | 337 | | | 106 |
| Tomaszów Mazowiecki | 64.5 | | 59 | 107 | 164 | | | 63 | | | | | | 273 | | 43 |
| Bełchatów | 59.3 | 83 | | | | | | | | | 445 | | | | 157 | 27 |
| Zgierz | 57.4 | | 177 | 120 | 184 | | | 71 | | 79 | | | | | | 83 |
| Skierniewice | 48.7 | 51 | | | | | | 167 | | 279 | | 232 | 232 | | | 73 |
| Radomsko | 47.4 | | 27 | 145 | | | | | | 191 | | 119 | | | | 42 |
| Kutno | 45.4 | 382 | 56 | | | | 268 | 268 | 317 | | | 374 | 249 | | | 157 |
| Zduńska Wola | 43.3 | 171 | 88 | | 244 | | | 281 | 332 | | | 131 | | | 430 | 128 |
| Sieradz | 43.1 | 115 | 176 | | | | | | | | | 263 | | | | 92 |
| Łowicz | 29.2 | 85 | 130 | | | | | 139 | 493 | 310 | | | | | | 109 |
| Wieluń | 23.3 | 106 | 109 | | | | | 174 | | 194 | | | | | | 85 |
| Opoczno | 22.0 | | | | | | | | | 412 | | | | | | 36 |
| Aleksandrów Łódzki | 21.2 | | 60 | | | | | | | | | | | 829 | 439 | 56 |
| Ozorków | 20.1 | 370 | 126 | 343 | | | | 202 | | | | | 564 | | | 158 |
| Łask | 17.9 | 276 | | 385 | | | | | | | | | | | | 66 |
| Konstantynów Łódzki | 17.9 | | 426 | 386 | | | 682 | 227 | 806 | | | 317 | | | | 244 |
| Rawa Mazowiecka | 17.7 | 558 | 214 | | | | | | | | | | | 1984 | | 201 |
| Głowno | 14.8 | 168 | 257 | | | | | | | | | 383 | | | | 134 |
| Łęczyca | 14.7 | 169 | 86 | | | | | | | 309 | | | | | | 81 |
| Koluszki | 13.4 | 185 | 95 | | | | 911 | | | 338 | | | | | | 118 |
| Brzeziny | 12.6 | | | | | | | | | | | | | | | |
| Wieruszów | 8.7 | | 293 | | | | | | | | | | | 2033 | | 137 |
| Żychlin | 8.5 | 290 | | | | | | | | | | 1325 | | | | 139 |
| Zelów | 7.8 | | | 884 | | | 1565 | | | | | | | | | 102 |
| Poddębice | 7.8 | 318 | 163 | | | | | | | | | | | | | 102 |
| Tuszyn | 7.3 | | 347 | | | | | | | | | | 1547 | | | 162 |
| Pajęczno | 6.8 | 1093 | | | | | | | | | | | | | | 175 |
| Sulejów | 6.4 | | | | | | | | | | | | | | | |
| Działoszyn | 6.1 | | | | | | | | | | | | | | | |
| Krośniewice | 4.5 | 550 | | | | | | | | | | 1257 | | | | 176 |
| Drzewica | 4.0 | | | | | | | | | 1136 | | | | | | 99 |
| Przedbórz | 3.7 | | | | | | | | | | | | | | | |
| Stryków | 3.5 | | | | | | | | | | | | | | | |
| Rzgów | 3.4 | | | | | | 3590 | 1197 | | | | | | | | 233 |
| Złoczew | 3.4 | 732 | | | | | | | | | | | | | | 117 |
| Warta | 3.3 | | 379 | | | | | | | | | | | | | 119 |
| Biała Rawska | 3.2 | | | | | | | | | | | | | | | |
| Uniejów | 3.1 | | | | | | | | | | | | | | | |
| Kamieńsk | 2.9 | 861 | | | | | | | | | | | | | | 138 |
| Wolbórz | 2.4 | | | 2915 | | | | | 6094 | | | | | | | 335 |
| Błaszki | 2.2 | | 565 | | | | | | 6423 | | | | | | | 353 |
| Szadek | 2.0 | 2445 | | | | | | | | | | | | | | 391 |

Source: authors based on unpublished CSO data

*Figure 7.* Divisional structure of large industrial entities in the urban settlements of Łódzkie Voivodeship in 2014

| Urban settlement | Population ('000) | C10–C12 | C13–C15 | C16–C17 | C18 | C19 | C20–C21 | C22 | C23 | C24–C25 | C26 | C27–C28 | C29–C30 | C31 | C32–C33 | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Łódź | 706.0 | 45 | 82 | | 224 | | | | 32 | 82 | 112 | 140 | 45 | | 90 | 65 |
| Piotrków Trybunalski | 75.6 | | | | | | | 419 | | 571 | | | | 698 | | 143 |
| Pabianice | 67.2 | 236 | | | | | 1178 | | | 214 | | | | | | 129 |
| Tomaszów Mazowiecki | 64.5 | 245 | | | | | | | 351 | | | | 491 | | | 101 |
| Bełchatów | 59.3 | | | | | | | | | | | | | | | |
| Zgierz | 57.4 | | | | | | | 552 | 394 | | | | | | | 76 |
| Skierniewice | 48.7 | | | | | | | 651 | 465 | | | | | | 651 | 134 |
| Radomsko | 47.4 | 334 | | | | | | | 477 | 304 | | | | 1114 | | 183 |
| Kutno | 45.4 | 698 | | | | | | | | | 1745 | 436 | 698 | | | 239 |
| Zduńska Wola | 43.3 | | 665 | | | | | 731 | | | | | 731 | | | 200 |
| Sieradz | 43.1 | | | | | | 919 | | | | | | | | | 50 |
| Łowicz | 29.2 | 543 | | | | | | | | | | | | | | 74 |
| Wieluń | 23.3 | 680 | | | | | | | | | | 849 | 1359 | | 1359 | 372 |
| Opoczno | 22.0 | | 655 | | | | | | 1030 | | | | | | | 197 |
| Aleksandrów Łódzki | 21.2 | | | | | | | | | | | | | | | |
| Ozorków | 20.1 | | | | | | | | 1127 | | | | | | 1578 | 216 |
| Łask | 17.9 | | 804 | | | | | | | | | | | | | 121 |
| Konstantynów Łódzki | 17.9 | | 806 | | | | | | | | | | | | | 121 |
| Rawa Mazowiecka | 17.7 | | | | | | | | | | | | | | | |
| Głowno | 14.8 | | | | | | | | | | | | | | | |
| Łęczyca | 14.7 | 1080 | | | | | | 2160 | | | | | | | | 296 |
| Koluszki | 13.4 | | | | | | 2961 | | | 1077 | | | | | | 324 |
| Brzeziny | 12.6 | | | | | | | | | | | | | | | |
| Wieruszów | 8.7 | | 1664 | 18299 | | | | | | | | | | 6100 | | 752 |
| Żychlin | 8.5 | | | | | | | | | | | 2318 | | | | 254 |
| Zelów | 7.8 | | 1849 | | | | | | | | | | | | | 279 |
| Poddębice | 7.8 | | | | | | | | | | | | | | | |
| Tuszyn | 7.3 | | | | | | | | | | | | | | | |
| Pajęczno | 6.8 | | | | | | | | | | | | | | | |
| Sulejów | 6.4 | | | | | | | | | | | | | | | |
| Działoszyn | 6.1 | | | | | | | | | | | | | | | |
| Krośniewice | 4.5 | | | | | | | | | | | | | | | |
| Drzewica | 4.0 | | | | | | | | | 3613 | | | | | | 544 |
| Przedbórz | 3.7 | | | | | | | | | | | | | | | |
| Stryków | 3.5 | | | | | | | | | | | | | | | |
| Rzgów | 3.4 | | | | | | | | | | | | | | | |
| Złoczew | 3.4 | | | | | | | | | | | | | | | |
| Warta | 3.3 | | | | | | | | | | | | | | | |
| Biała Rawska | 3.2 | | | | | | | | | | | | | | | |
| Uniejów | 3.1 | | | | | | | | | | | | | | | |
| Kamieńsk | 2.9 | | | | | | | | | | | | | | | |
| Wolbórz | 2.4 | | | | | | | | | | | | | | | |
| Błaszki | 2.2 | | | | | | | | | | | | | | | |
| Szadek | 2,0 | | | | | | | | | | | | | | | |

*Source: authors* based on unpublished CSO data

the voivodeship for foreign investors (Domański, 2001). As a result, settlements in the voivodeship show a low variety of functions (Śleszyński, 2007).

## The economic base and functions of urban settlements

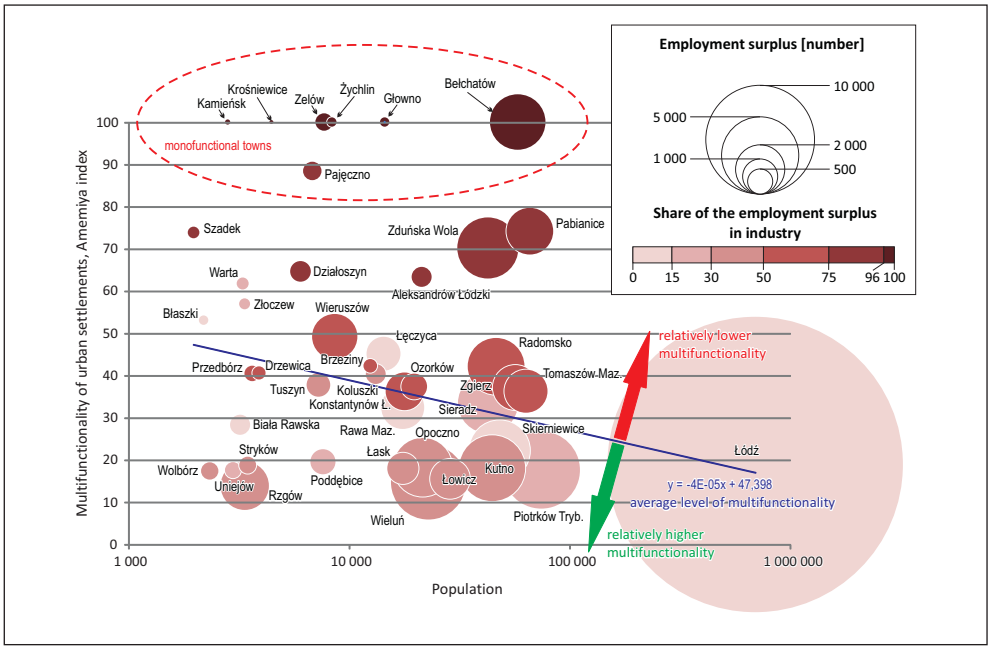
From the perspective of labour markets, the economic base of urban settlements, that is the size of their exogenous functions and functions, can be determined as described above based on an employment surplus. The degree of multifunctionality of this base, i.e. the diversification of functions, increases the resilience of a settlement's economy to fluctuations, while monofunctional settlements in the long term show cyclical and significant fluctuations in growth and recession. In general, a concentration of economic activity results in an increasing exogenous employment surplus with an increase in the size of urban settlements. The absolute value of this surplus does not always mean a more significant share of exogenous functions (Figure 8).

Both the size of the economic base and the diversification of functions showed a dependence on the size of the settlement, while the size of the economic base was proportional to the size of the settlement. Large towns deviated from this pattern: Pabianice, Tomaszów Mazowiecki and Zgierz showed a relatively low level of employment surplus. Others were urban settlements with a relatively high level compared to their size, Konstantynów Łódzki and Wieluń among medium towns, and Rzgów and Wieruszów among small and very small ones (Figure 8). In terms of the level of specialisation, a decrease in the value of the Amemiya index was observed with the size of the settlement and this demonstrated an increase in the diversification of the economic base, and therefore multifunctionality, among larger towns. Linear regression was determined by the average level of diversification of functions in the urban settlements of Łódzkie Voivodeship concerning their size. Settlements located above this line showed a lower than expected level, and those located below a higher level of diversification. The settlements for which the value of the specialisation index ranged from 90 to 100 were monofunctional and were mainly small and very small towns, except for Bełchatów, the only large town in this group (Figure 8).

It should be noted that all these urban settlements showed a concentration of the total surplus of those working in industry, and the share of industry in functions increased with the decline in the multifunctionality of the settlement. On the other hand, the share of industry in the economic base was inversely proportional to its size, except large towns where no relationship between these features was observed (Figure 8).

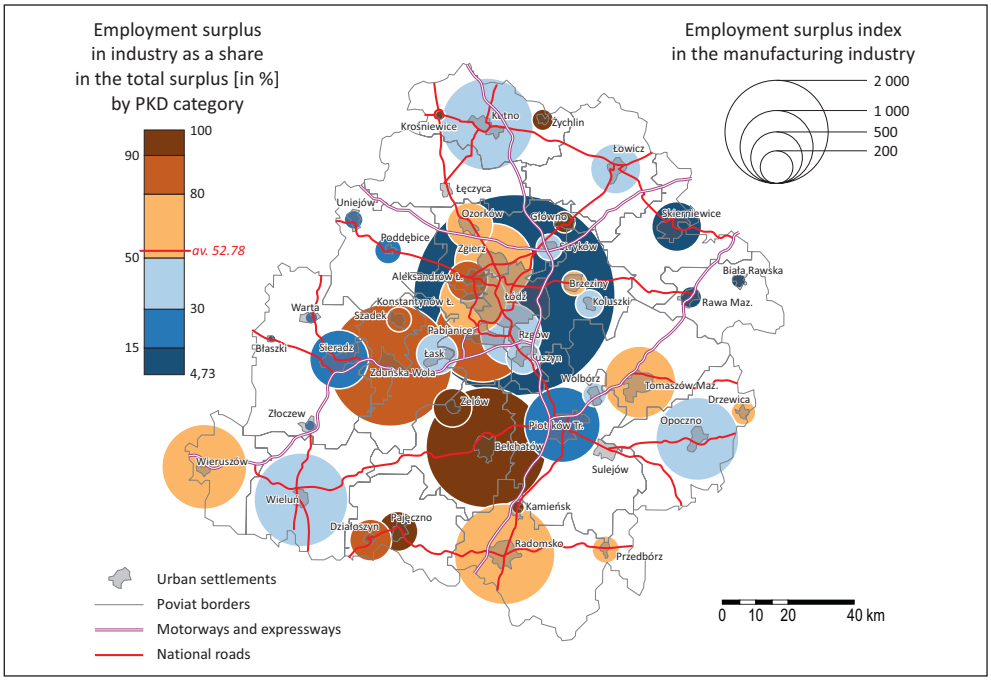
The size of the surplus working in activities related to industry was also presented in the diagram (Figure 9) with its highest value concerning the city of Łódź. However, it should be noted that this ratio was not so high in terms of size of Łódź and was followed by Zduńska Wola and Bełchatów. In the case of the former, part of the surplus was also generated in the service sector. Bełchatów, on the other hand, was a monofunctional town in this respect, as the entire figure resulted from the development of industry. The next highest are Pabianice, Wieluń, Kutno and Radomsko, and of these, mainly Pabianice, but also Radomsko, were towns where the surplus indicated their industrial character. On the other hand, Wieluń and Kutno were examples of the most multifunctional settlements in Łódzkie Voivodeship. The relatively large share of industry and the very size of the employment surplus was high in towns in the western part of the Łódź agglomeration. Apart from Pabianice, this applied to Zgierz, Konstantynów

*Figure 8.* Exogenous functions of urban settlements in Łódzkie Voivodeship by settlement size and share of the manufacturing industry



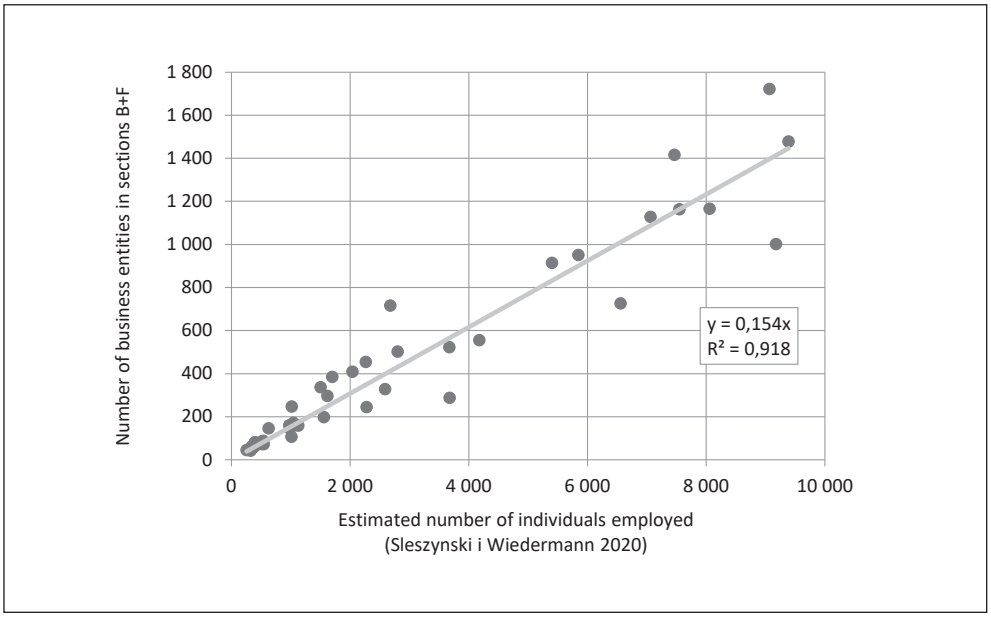

Source: authors based on data from Śleszyński, Wiedermann (2020)

*Figure 9.* Employment surplus in the manufacturing industry and its share in the total surplus




Source: authors

*Figure 10.* Comparison of the registered business entities and the estimated numbers of employed individuals in the cities of Lodz Voivodeship in 2016. (City of Lodz was omitted, since its numbers were by a decimal point higher than those of other largest cities)




Source: based on BDL GUS data and Śleszyński, Wiedermann (2020) estimates

Łódzki, Ozorków and Aleksandrów Łódzki and in addition to these, a large surplus size and its industrial nature also applied to Wieruszów and Tomaszów Mazowiecki, and, to a lesser extent, Pajęczno and Działoszyn.

To end, it's worth to contrast results concerning economic base, derived based on the estimated number of individuals employed, with numbers of business entities overall (graph 10). It turns out that the data from both sources fits together relatively well. It does not mean, however, that one can be replaced with the other, because deviations from the observed regression, especially in bigger cities, are relatively large and at times amount up to several percentage points.

## CONCLUSIONS

The above analysis and previous studies on changes in the economy as well as the economic base and functions of the settlements of Łódzkie Voivodeship, lead to conclusions that achieve the cognitive, methodological and application objectives of this work.

It was demonstrated, the concentration level of businesses per 1000 inhabitants depended to a lesser extent on the size of the settlement and more on its location in relation to the Łódź agglomeration and on historical and contemporary development paths. However, when it comes to the dynamics of processes, the spatial structure of the urban system in the voivodeship showed an increase in the already strong economic potential of Łódź and the settlements of the Łódź agglomeration, except for its northern zone, with the weakening or stagnation in this respect of border towns and

the relatively large settlements located to the south and south-east of the Łódź agglomeration. This situation, indicating their marginalisation, may have complex causes:

1. Erosion of development factors – as confirmed by commuting routes (*Strategia*..., 2013): to the core of the settlement system, i.e. Łódź and the Łódź agglomeration; as well as to the labour market in the area of mining and energy in the gmina of Kleszczów from Bełchatów, Piotrków Trybunalski and Radomsko; and to the metropolitan area of Warsaw from the towns near the north-eastern borders of the voivodeship;
2. Exhaustion of existing functions and the lack of new developments in Piotrków Trybunalski, Tomaszów Mazowiecki, Radomsko, Kutno, Wieluń and Wieruszów which was confirmed by slow structural changes in the economy or stagnation in these areas.

In turn, the analysis of the various size economic entities divisional structure in the urban settlements of the voivodeship indicates:

1. The concentration of industrial activity in towns of the Łódź agglomeration regardless of size, in urban settlements in the southern and northern parts of the voivodeship, and terms of medium industrial entities also in settlements of various sizes located to the west of the Łódź agglomeration;
2. The impoverishment of industrial activity in urban settlements of various sizes in the south-eastern and partially in north-eastern areas, as well as in Bełchatów and Tomaszów Mazowiecki, the causes of this are varied and complex;
3. Structural inertia of industry, where traditional industries still play the most important role, mainly clothing, textiles and food processing, and much less represented are the sectors of high and medium-high technology, mainly chemical and pharmaceutical as well as electrical engineering and machinery;
4. Decreasing diversification of industry and an increase in the size of economic entities along with decreasing population size.

Industry continues to be an important component of the economic base in the settlements in Łódzkie Voivodeship, determining the size of this base in more than half of the urban settlements, including most large, medium and very small ones, which resulted from changes in their economies. The further development of large and medium urban settlements and their role in the settlement system depends on the reduction of the share of industry in favour of knowledge-based services and the growth of multifunctionality. In contrast, the development of small and very small towns depends to a large extent on the possibility of developing resources to increase the scale of manufacturing industries.

In very small, small and medium towns, which play the role of local centres, the basis for shaping the economic base and specialised exogenous functions, integrating them into global networks of connections, should be based not only on the traditions and endogenous potential of the region but also on knowledge. Product or technological innovation of such an industry could be based on unique design, the use of mechatronics, ICT, nanotechnology and functional materials or biotechnology (*Regionalna Strategia...,* 2013; *Regionalny Program...,* 2014; *Strategia...,* 2013). Such a model of development and location, especially in settlements located in the periphery of large towns and the Łódź agglomeration, is favoured by:

1. An important factor in the location of the industry based on biotechnologies, such as agricultural raw materials, with the location of large R&D facilities in towns (Dorocki, Jastrzębski, 2012; Dorocki, Boguś, Jastrzębski, 2014);
2. Improvement of transport accessibility, facilitating the inflow of human capital and links with entrepreneurship institutions, including R&D in large cities;
3. Relatively low real estate prices and rent, decreasing along with the distance from the core of the settlement system, with a large supply of free investment areas which is important due to the area-intensive nature of manufacturing industry;
4. The process of industrial relocation described above, unfavourable in the period of system transformation, may now, through emerging networks of functional connections, trigger multiplier effects and processes of spreading development. However, excessive relocation of industry can lead to uncontrolled economic growth on the periphery and spatial chaos, which in the long run may create barriers to development.

In the case of Łódź, further development of exogenous functions should include mainly specialised, metropolitan functions, shaped by knowledge-based services such as research and development, production of films, TV programs and recording, and publishing activities, as well as cultural, entertainment and sports activities along with specialised health care and education at the higher and secondary technical level. These services, especially in the academic and R&D sectors, should contribute to an increase in the level of human capital and the development of industries with high and medium-high technology. It will allow the city's economy to be included not only in national, but also European and global networks, and for Łódź to play the role of a supra-regional centre.

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