THE TERRITORIAL NATURE AND POWER OF HUMAN CAPITAL IN URBAN DEVELOPMENT PROCESSES FROM THE PERSPECTIVE OF THE PATH DEPENDENCE CONCEPT

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ABSTRACT: Knowledge and human capital are gaining importance as determinants of urban and regional development on a global scale. We can observe a simultaneous increase in the mobility of human capital, the availability of knowledge, and an increase in the importance of location. This phenomenon is sometimes referred to as glocalisation. Mobile and highly valuable human capital are being territorialised. From the city's point of view, is this an opportunity or a threat? The question can be asked whether the territorialisation of human capital has an impact on the durability of urban development. It is not obvious whether it helps to develop competitive potential and competitive advantages of an area only temporarily or in the long term. An analysis using elements of the path dependency theory can provide answers to these questions. It considers both the complexity of the research subject and the evolutionary nature of development processes. Therefore, the fundamental question of this article is whether the territorialisation of human capital affects the durability of urban development. The main findings of the study show that both the size of a city and the rate of demographic growth affect the choice of the type of development path. Cities with high demographic growth rates and complex development strategies enter reactive paths. This type of path guarantees the durability of development processes.

KEYWORDS: city development, territorialisation of human capital, urban development paths, path dependence

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Introduction

Human capital plays an essential role in the development of cities and regions. It is shaped by global trends, which affect, among others, the change in spatial behaviour patterns (e.g. spatial mobility, consumption, lifestyle). At the same time, human capital is subject to territorialisation, as territories create favourable conditions for its concentration.

Despite the need for mobility and its growing opportunities, people are subject to embeddedness. However, the territory is not limited to the social dimension, and human capital is becoming an important subject in business relations The interpretation of the social embeddedness of the

economy is based on social institutions (Polanyi 1957; Granovetter 1985, 2005). Territorialisation is closely associated with embeddedness, but it more strongly emphasises the importance of proximity and territory with its properties in business relations (Torre 2014). Economic institutions created by people, such as companies, economic self-governments, cooperatives, associations, foundations and others, also produce relations with the territory, both with its spatial, social and business dimensions. Simple evidence in this regard can be seen, on the one hand, in the complexity of factors affecting the assessment of the investment attractiveness of a region (Snieska, Zykiene 2015) and, on the other hand, in the complexity of the category of 'exit' costs, which is the relocation of a company. Human capital is an important subject of various territorial economic networks based on the helixes concept, industrial clusters, circular clusters or industrial symbioses (Przygodzki 2018). The territorialisation of human capital offsets the impact of external processes such as globalisation or increasing opportunities for mobility, which Castells and Cardoso (2005) term spaces of flows. This process is relatively durable because of the benefits generated on both the individual and environmental sides.

The territory benefits from agglomeration and actively participates in the complex learning process. Human capital, as the main transmitter of knowledge and a resource subject to territorialisation, should also be considered as a component of territorial capital, determining the potential development of the territory.

Capello et al. (2009) emphasise that human capital is a fundamental component of territorial capital. Territories, especially cities and regions, compete to attract educated people ready to take up jobs in knowledge-intensive occupations. Consequently, such territories also concentrate creative and innovative capital, thus guaranteeing themselves an increase in development dynamics. Territories strengthen their competitive potential and build an advantage over other territories. The concentration of human capital also affects the activation and intensification of development in territorial units. However, a question arises about the durability and stability of this impact. Does once-accumulated human capital guarantee the development of the territory in the long term? Thus, the paper aims to identify how

the territorialisation of human capital affects the durability and the long lasting nature of urban development and to identify the type of path that affects its durability.

A concept that examines the durability of development is path dependence theory. Basically, path dependence theory concentrates on processes set in motion by a random historical event that directs them to a particular path. A path-dependent process develops as a consequence or as a function of its own history (David 1997; Churski 2008; Stachowiak, Stryjakiewicz 2008; Stryjakiewicz, Jaroszewska 2016). The path dependence theory concept also examines the factors that retain a process on a once-chosen path (David 1985). Considering the complexity and the multiplicity of the development factors, as well as their evolutionary nature, the concept of path dependence emerges as an appropriate research tool to examine the durability of the processes involved. Complexity and evolution also characterise knowledge-determined development processes, such as those that lead to the territorialisation of human capital.

Many authors argue that path choice is not random but emerges as a function of the properties of a place understood as territory (Krugman 1991; Boschma et al. 1999; Boschma 2007; Martin, Sunley 2010; Nowakowska 2011). Hence, the factors that cause path dependence are very often strongly local. Regions or cities differ on many levels: economic, institutional, and social, so the reasons why a path-dependent process occurs and how it develops will vary from place to place. Each location has its own path dependence profile (Martin, Sunley 2006). Thus, the territory (city or region) itself contributes not only to the emergence but also to the durability of the development path. Cities that are successful in more than one area perform better and are able to grow independently in a sustainable way (Jacobs 1970). Jacobs (1970) illustrated that relation with the examples of Los Angeles (with multiple development paths) and Detroit (one industry-based development path). This clearly indicates that the durability of development also depends on the type of path. The literature distinguishes two types of paths: reactive and self-reinforcing (Arthur 1994; David 1997; Mahoney 2001; Gwosdz 2014). For this reason, the second research question has been posed:

how does the type of path affect its durability? Responses to the above questions are given based on research conducted in all towns and cities in the Lodz Region, in Poland. The innovation of the conducted analysis lies in the use of a case study method for cities in a culturally diverse region. The current Lodz Region is situated at the junction of three historical provinces of Poland. This fact has influenced the specificity of the region's settlement network, which is formed by cities diverse in terms of the time of their foundation and the factors that initiate their formation and development.

Study area: Theoretical background

The territorial dimension of human capital

The approach to the role of human capital in the economy has changed over time. Mincer, Schultz and Becker are considered the pioneers of modern human capital theory. Although considered separate research, their views contained common ground – they believed that people spend their income differently, thinking about current needs and considering potential future profit (Schultz 1961; Becker 1962, 1990; Kunasz 2003). In their claims, they did not directly refer to the dependency of human capital on the local socio-economic environment. However, they indicated that factors related to the education system depend on the characteristics of local and regional systems (Matur 1999).

Research on the relationship between the value of human capital and the environment was initiated by Lucas and Romer, who were the first to write about the endogenisation of technological progress and the endogenisation of human capital accumulation (Matur 1999). Lucas described human capital as the result of both external and internal productivity and highlighted elements specific to particular places and communities (Acs, Sanders 2021). Lucas and Rossi-Hansberg (2002) drew attention to two factors of human capital development: school education and practical learning. Liu and Jiang (2018) proved that the improvement of human capital not only has the internal effect of enhancing production capacity but also has the external effect of improving the overall production capacity of society.

This topic was addressed by Eppelsheimer et al. (2022), who argued that proximity determines the strength of externalities of high-quality human capital. Much research has been carried out to find the relations between education levels and wages in cities and metropolitan areas (Rauch 1993; Glaeser, Saiz 2003). Romer (1989) treated human capital as a dominant transmitter of technological progress. Research on this topic was conducted by, among others, Alani (2018), Growiec and Schumacher (2013), and Olsson (2005). Banerjeea and Roy (2014), and Hu (2021) consider investment in human capital as a catalyst for technological innovation. Jones (1996, 2001) presented a model in which human capital is both a determinant and a carrier streamer of technological progress. The GREMI Research Group (Groupe de Recherche Européen sur les Milieux Innovateurs) proved that the diffusion of technology and innovations are generated in an innovative entrepreneurial milieu subject to territorialisation (Aydalot 1986; Crevoisier 2004). The unified theory of economic growth of Galor (2011b) explored the interaction between human evolution and economic development. In this theory, human capital, along with technological progress, is the primary cause of sustainable economic growth (Galor, Moa 2004).The relationship between human capital and economic growth was confirmed also by Galor (2005, 2011a), Čadil et al. (2014), and Pelinescu (2015).

Human capital, as well as material and financial capital, tend to be spatially concentrated in areas with a high level of development. These areas are seeing increased investment in people, which is both planned (as part of state or local government policy) and spontaneous (due to neighbourhood and proximity; Wixe 2016). The factors determining the concentration of human capital are migration and mobility of people. A strong tendency for the spatial concentration of human capital is observed mainly in large cities (growth poles), leading to disparities in human capital distribution (Rauch 1993). The concentration of human capital can lead to the peripheralisation of development and marginalisation of some units. Therefore, globally and regionally, there is a danger of so-called islandness or the peripheralisation of economic growth (Lang et al. 2015).

Many hands to work and basic professional skills are no longer factors that can accelerate the territory's economic growth rate (Gaczek 2007). Such characteristics of labour resources do not determine the innovation processes necessary to create added value. There are limited opportunities for knowledge diffusion both within the entrepreneurial environment and between the local level and the external environment (international and global). In other words, the deficit of human capital with innovative and advanced knowledge negatively affects the investment attractiveness of the territory and the ability to exploit development opportunities.

Human capital and the durability of development processes in the path dependence concept

The path dependence concept, intended originally to explain technology-adoption processes and industry evolution, emerged from the theory of evolutionary economics. The concept assumed that history matters and linked critical decisions made in the past with the present and future situation. The concept can be used to explain dynamic economic, social and spatial processes, which are random but irreversible or difficult to change (David 2001). It is also valuable for explaining non-typical, exceptional events that produce consequences outside the scope of generally approved theories (Mahoney 2000).

Theoretical foundations of the path dependence concept were laid by David (1985), who defined a path-dependent process as a process that evolves as a consequence or function of its history. The process is triggered by a random historical event, which directs it towards a particular development path (David 1997, 2001). The choice of a solution is also 'accidental', which is why the solution is not necessarily the best or the most efficient of all available options (Mahoney 2000; Vincensini 2001; Gwosdz 2004).

There are two distinguished types of paths, depending on the mechanism that triggers the development and strengthens the process alongside the path:
1. self-reinforcing, in which the direction of development is given in the first step and later reproduced as a result of increasing returns (Mahoney 2000). Leaving or changing the development path is impossible because, over time, the chosen solution produces increasingly greater benefits. As a result, a development path gets lock-in (Mahoney 2001);
2. reactive, defined as a sequence of events that have a causal connection to subsequent events over time. Unlike in the self-reinforcing path, no mechanism would reproduce subsequent steps. The initiating event triggers a sequence of closely linked events which transform one another (Mahoney 2000). In a reactive sequence, events on the path are driven by natural logic: each event corresponds to an earlier one and is the cause of a follow-up event (Mahoney 2000). Leaving or changing the development path is impossible because, over time, the chosen solution brings increasing benefits. The effect of this is to lock-in on the path (Mahoney 2001).

Nevertheless, studies on the concentration of human capital and flexible innovation systems determined by the quality of innovative industrial milieus and its properties showed that such interpretation of the path dependence concept was too narrow (Capello, Lenzi 2018). Changes in the interpretation of the role of innovation in development, especially in a knowledge-based economy, have led to changes in the path dependence concept. Innovation has become a social and organisational process, and results from activities undertaken in the local community (Nowakowska 2011). Additionally, the contemporary interactive innovation model class is based on a network concept and systemic operations. All of these elements can be found in properties typical of innovative milieu and the territorial approach to development (Moulaert, Sekia 2003).

The primary path dependence concept was accused of not considering the location's relevance and its impact on path development. To explain the concentration of economic activity in a particular area or the development mechanisms of single spatial units (cities, regions), the concept of path dependence was modified (Krugman 1991). Boschma (2007) criticised the previous path dependence models for considering only the impact of a particular path on a given place. In his point of view, there is feedback, and that is why the place (location) also impacts on the development path (as it is a place-dependent process). This is

a result of the diverse dynamics of various proximity dimensions (Balland et al. 2015, 2022). The randomness of a place-dependent process is related to the omnipresence of general conditions necessary for the development of modern industries which can be found in many regions and cities. This is why the emergence place of new industries is unpredictable. So, a random event means the inability to specify where a particular branch of industry will develop (Boschma 2007; Boschma, Freneken 2018).

Martin and Sunley (2010) also pointed to the dependency on place. In their opinion, many mechanisms triggering the path dependence process have local character; hence, it is impossible to specify universal factors behind the process. Regions or cities differ on many levels: economic, institutional or social, so the reasons why a path-dependent process takes place and how it evolves are different in different places. Each location has its path dependence process (Martin, Sunley 2006; Martin 2021). In recent research, Jolly et al. (2020) pointed out that path dependence is also shaped by many types of actors and agencies that also vary across regions/cities. The role of actors in the path dependence process was also underlined by Baumgartinger-Seiringer et al. (2022).

Both path-dependent and place-dependent processes lead to lock-in on the path. No matter whether the path is reactive or self-reinforcing, lock-in is one of the stages of its development. If lock-in happens, a region or city becomes unable or hardly able to launch an internal evolution. The situation can be overcome if there is a powerful external incentive, referred to as the turning point. Embarking on a new path must be preceded by profound changes in the system settings (Mahoney 2000; Gwosdz 2004). However, it raises the question of which of these paths is more durable and safer for the development of territorial units: self-reinforcing or reactive. Jacobs (1970) demonstrates that cities that are successful in more than one field are able to evolve by themselves in a long-lasting and durable way. The statement is illustrated with the examples of Los Angeles (a multiplicity of development paths – a reactive path) and Detroit (one leading development path based on one industry – a self-reinforcing path).

Materials and methodological approach

The territorial scope of the study covered the Łódź Region, the central region of Poland. As an administrative region, the Łódź Region was established in 1919. However, the history of its lands dates back to the 10th century. The territories now constituting the Łódź Region are located at the junction of three historical provinces of Poland: Greater Poland, Lesser Poland and Mazovia. In the Middle Ages, there were four large administrative units here – the provinces of Łęczyca, Sieradz, Rawa Mazowiecka and the land of Wieluń, with five main urban centres: Łęczyca, Łowicz, Piotrków Trybunalski, Rawa Mazowiecka and Sieradz. The primary source of income for these areas was forest-related activities and agriculture. The medieval urban centres were only organisers of local settlement networks. The 19th century Industrial Revolution affected the development of the area in a very significant way. Industrialisation did not extend to the historically formed centres of power and governance, and industrial companies were located in cities established in *cruda radice*. The process of industrialisation was the most important factor shaping the local settlement network (Liszewski 1989). Thus, the current settlement network of the Łódź Region is formed by both old towns of medieval origin, such as Łęczyca or Piotrków Trybunalski, and young towns of 200 years of age, such as Konstantynów Łódzki or Ozorków. Such a specific way in which the settlement network of the Łódź Region was shaped meant that different factors decided about the development of individual cities, and their development paths were different. Their location was also significant, which determined and shaped the development factors. At the end of 2019, the settlement network of the Łódź region consisted of 44 cities. The research was carried out in all units, excluding the region's capital (Łódź). A total of 43 cities were studied (Fig. 1).

Using theories explaining economic solutions for local policies (such as the theory of public choice, the Tiebout model and the concepts of localism and territorialisation), we assumed that the indicator of demographic change reflects the overall potential of human capital, which is determined by the attractiveness of a place. We treat this indicator as an outcome measure of the

potential of human capital and as information regarding the extent of the attractiveness of a place to the demand reported by potential city users and, consequently, residents. Since urban sprawl does not significantly affect the development of the studied cities, it was assumed that the study of human capital through demographic changes was justified. The development potential of the studied territorial units is not distorted by suburbanisation. The research subjects were all cities in the Łódź region, excluding the regional capital (Łódź). Thirty of the surveyed cities were small cities (up to 20,000 residents by Statistics Poland). Thirteen cities fall into medium-sized cities (>20,000 to 100,000 residents by Statistics Poland). Among the small units we studied, no towns face population outflow problems due to urban sprawl. All of the small towns (30 of the 43 surveyed units) are devoid of the urban sprawl issue. In the small towns studied, we identified the problems of low or even negative natural growth, unfavourable migration phenomena, and the development of new areas within the administrative borders. However, these processes are due to natural demographic processes, changes in trends and lifestyles, the transformation of
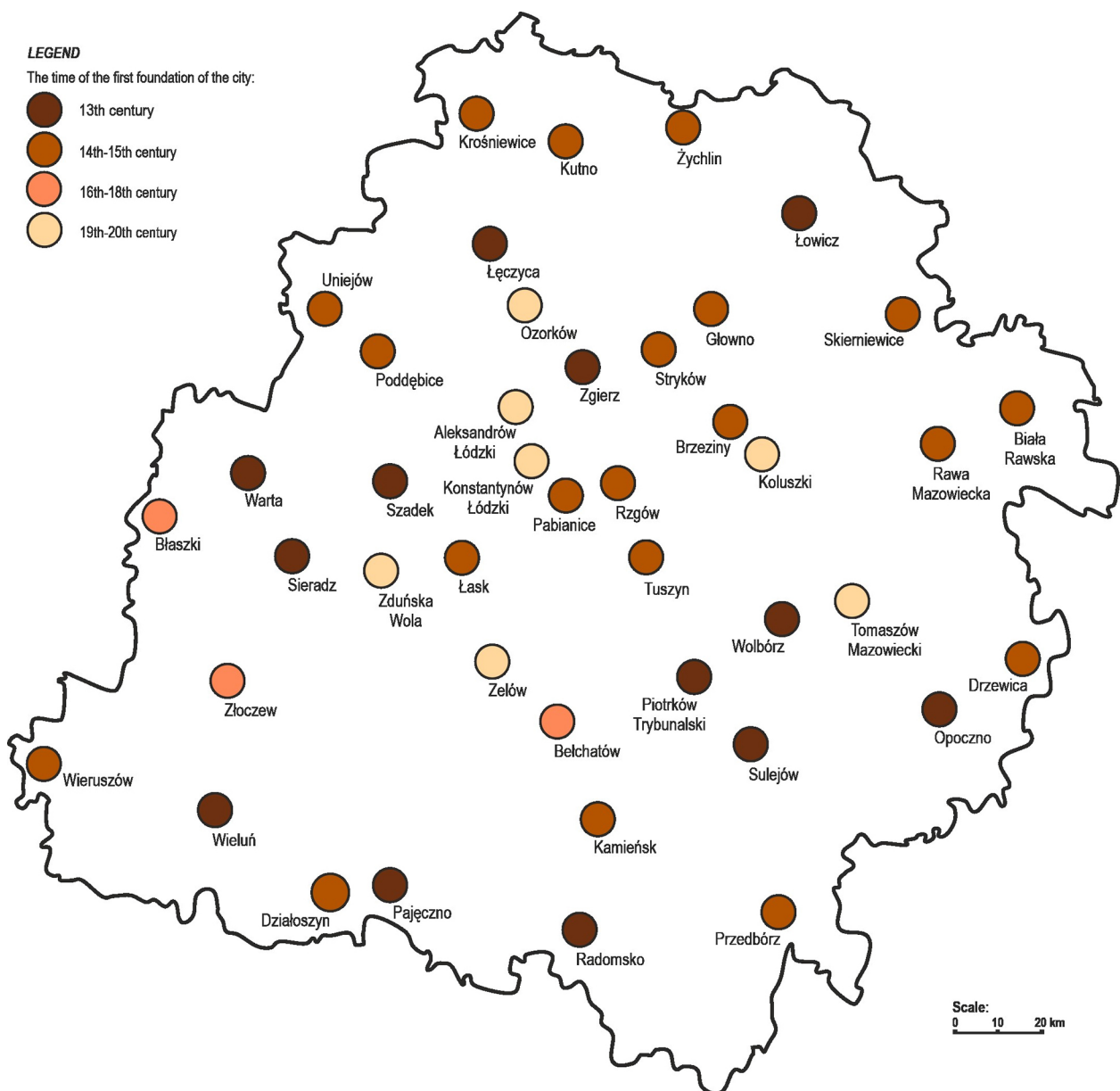

Fig. 1. Location of the studied cities/towns in the Łódź Region.
Source: own compilation.

agriculture and labour markets, and the competitiveness of other units. The scale of urbanisation of sub-urban zones, especially outside the urban administrative borders, is minimal. Three of the 13 medium-sized surveyed cities were located in the influence zone of suburbanisation of the regional capital of Łódź. This means that these cities benefit from the degradation processes of this core city. In this case, it is a factor determining the development potential of these cities. This is not, however, such a predominant phenomenon, as in two cases (Pabianice and Zgierz) it does not offset these cities' negative naturalised growth and migration balance (MB). Only Aleksandrów Łódzki (about 22,000 residents) has a positive MB and natural increase. In the other 10 medium-sized cities, the suburbanisation phenomena also did not occur or were incidental. To confirm this, we use the results of the Urban Policy Observatory in the Institute for Urban and Regional Development's 2023 study. This research identified urban sprawl using an indicator: the proportion of multi-family and developer housing in suburban zones from 2013 to 2020. The results of this research indicated that suburbanisation does not occur in cities such as Łowicz, Radomsko, Sieradz and Skierniewice. There is a lack of multi-family housing and a low level of developer housing in Piotrków Trybunalski and Kutno. A low level of multi-family housing and a low level of developer housing occurred in Zduńska Wola and Tomaszów Mazowiecki. A medium level of multi-family housing and a low level of development construction were identified in Wieluń. In Bełchatów, there was no multi-family housing and only a medium level of development housing (Sykała et al. 2023). We define a development path as the evolution of a settlement unit (e.g. a city), which takes place through the transformation of its constituent spheres (e.g. economic, social, and cultural). The history of the unit shapes the direction of the evolution, and results in the expansion of the path structure and the emergence of sub-paths. The sub-path is understood as a component of the development path of a settlement unit that is related to a specific sphere forming the examined unit (e.g. economic sub-path, cultural sub-path). It was also assumed that throughout its existence, the town/city had a trade and services sub-path, referred to as the basic path (Guz 2018).

The paper aims to identify how the territorialisation of human capital affects the durability and the long-lasting nature of urban development and to identify the type of path that affects its durability.

To achieve this aim, the following hypothesis was formulated:

H1: the territorialisation of human capital in the city triggers a reactive path, which is characterised by the durability of development. In order to verify the assumed hypothesis, a three-stage study was conducted:

a) identification of human capital concentration in the context of its territorialisation in the examined cities;

b) identification of types of paths in the examined cities and their complexity;

c) identification of the relationship between the concentration of human capital and the type of development path and its complexity.

(a) The identification of cities/towns with positive demographic balance helped us indicate units in which human capital represented an essential component of territorial capital. We analysed demographic changes in the examined cities from 1975 to 2020 (data for years before 1975 were not available). Population changes can be caused by positive natural growth, migration or expansion of administrative boundaries. To see which factor had a decisive influence on population growth, Webb's typology was used. It demonstrates the relationship between natural increase and MB (Webb 1963).

(b) Firstly, we have prepared an analysis of institutional endowment related to investments in human capital to identify path complexity. The analysis was calculated in four areas directly connected with the quality of human capital: culture, science and research, leisure and tourism, and health. While constructing the institutional endowment matrix for the units covered by the study, we considered the presence or absence of an institution in a particular town (we did not examine the overall population of institutions of a specific type). We examined the presence of the following:

– cultural institutions: cinemas, museums, theatres, philharmonics, art galleries, local mass media (radio, TV, press),

- science and research institutions: higher education institutions and their affiliates (including seminaries), research and scientific institutes, statistical offices, national archives,
- leisure and tourism institutions: accommodation facilities (at least 3), food and beverage facilities (at least 5), tourist information offices, and
- health institutions: general hospitals, specialised hospitals, sanatoriums.

Each institution was given a weight according to the formula (Gwosdz 2004; Guz 2018):

$$W_i = 1 - {}^i/{}_I$$

where: W_i – institutional weight index; i – population of institutions of a particular type; I – total population of institutions within a given type of development path.

We assumed that the less frequent an institution's occurrence, the greater its importance and the greater its weight should be – for this reason, the resulting quotient was subtracted from unity. The weights for individual institutions in each of the studied localities were then totalled. The complexity of development paths, determined by human capital, was identified using the rho-Spearman rank correlation coefficient.

The second step in identifying path complexity was focused on an economic base of cities (economic sub-path). Considering the Florence specialisation coefficient, we checked how many branches of industries existed in a particular city. This coefficient was verified by a factor Wi >1.5 (when it was <1.5, we did not recognise specialisation in the economic sub-path).

Given the number of identified sub-paths, we divided them into simple (consisting of a basic sub-path and one sub-path), compound (a basic sub-path and two or three sub-paths) and multiple compound paths (a basic sub-path and four or more sub-paths, Fig. 2). We classified towns/cities with compound and multiple compound paths as reactive. Cities with a simple development path were considered a self-reinforcing type.

To complement the quantitative research on the complexity and types of path, we used the historical-evolutionary method proposed by Guz (2018). This method involves identifying key events in the history of a city that can be considered turning points. These turning points can cause a sub-path's closure or a new one's opening (Appendix 1).
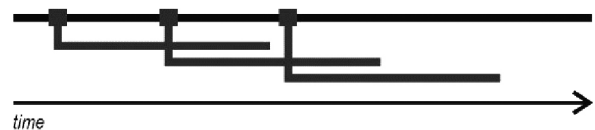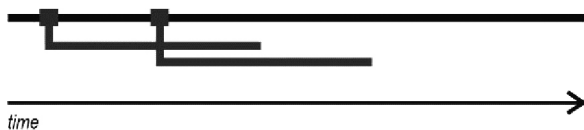
(c) To identify the association between the complexity of development paths and the population of the examined cities, we used the rho-Spearman rank correlation coefficient and Cramer's *V* contingency coefficient.

We carried out χ^2 independence tests to examine the dependence of the type of development

Simple path:
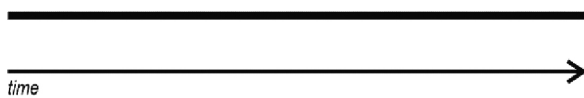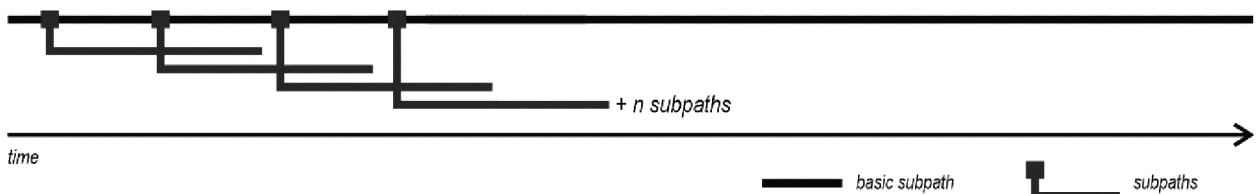

Compound path:

Multiple compound path:

Fig. 2. Types of development paths depending on the degree of their development.
Source: own compilation.

path on three properties of the embedded human capital:

- the average rate of demographic growth (a quantitative variable changed to an ordinal qualitative variable so that 0 denotes the value of the rate of change below the first quartile, 1 – the value between the first quartile and the median, 2 – the value between the median and quartile 3, and 3 – the value above the 3rd quartile);
- the size of the urban population (a quantitative variable changed to an ordinal qualitative variable so that 0 denotes the value of the rate of change below the value of the first quartile, 1 – the value between the first quartile and the median, 2 – the value between the median and quartile 3, and 3 – the value above the 3rd quartile);
- the degree of complexity of the development path (an ordinal qualitative variable, where 1 – simple, 2 – compound, and 3 – multiple compound).

Results: Identifying the specificity of human capital determined by development paths

Territorialisation of human capital in the Łódź region: Demographic changes

Both in 1975 and 1989, almost all towns in the Łódź region reported a positive population balance. It was caused by high migration growth and a positive birth rate (BR). The examined cities and towns did not differ from other towns and cities in Poland. The high BR was a natural effect of World War II, and the post-war compensation baby boom experienced in the 1950s and echoed in the 1980s.

The high MB was caused by the communist political and economic system established in Poland. This new social, economic and political order shaped the image of urban life as a symbol of climbing up the social ladder, progress and better living conditions. The idea of intensive industrialisation turned towns and cities into big labour markets. Thus, somehow naturally, towns and cities became welcome destinations for migrants, especially from rural areas.

The trend reversed after 1989 and worsened until 2020. Most towns and cities faced depopulation, not only caused by low BRs but also by negative migration rates. The socio-political transformation of the 1990s triggered several changes in Poland that were not only political and economic but also social and demographic. Polish society entered into a second demographic transition, in which among others, suburbanisation processes started. The transformation process also significantly impacted the BR, as well as the size and direction of migration flows. In 2020, negative demographic trends were noted in most of the examined towns and cities (Table 1).

In the analysis of demographic changes, particular attention was paid in this case to cities showing a positive demographic balance resulting only from a positive MB (column D in Table 1), which in short indicates a high value of human capital and a relatively low level of territorialisation (embeddedness).

Poland's two changes in the political system (after World War II and after 1989) should be considered as a turning point in the development paths of the examined cities. They triggered increasing returns, which can be interpreted as an increasing/decreasing population here. These,

Table 1. Types of demographic growth in cities and towns of the Łódź region according to Webb's typology in the period 1975–2020.

Year	Type of demographic growth							
	Positive				Negative			
	A	B	C	D	E	F	G	H
	+BR ≥ MB	+BR > + MB	+BR < + MB	−BR < + MB	−BR > + MB	−BR ≥ MB	−BR ≤ MB	+BR ≤ MB
1975	5	4	21	–	–	–	2	5
1989	5	6	15	5	1	–	1	5
2020*	3	1	–	4	2	9	13	10

BR – birth rate; MB – migration balance.
* one town (Warta) was found on the limit of two categories C and D.
Source: own compilation based on Statistics Poland.

in turn, influenced the population's prosperity and the rise and growth of the creative class. Restricted access to human capital, especially when social and economic development rests on knowledge, undoubtedly produced profound changes in the local environment and the surrounding area.

In addition, the second set of factors that could exert powerful pressure on change includes institutional motives triggered by the change in the political system. It led to the restructuring of the economies in Central and Eastern Europe. These two factors generated shocks to urban systems and effectively or potentially altered their development paths.

Complexity and types of development paths in the Łódź region

Changes in the political system have also triggered changes in the institutional endowment of the examined towns and cities, as well as in their economies. Institutional endowment weights also showed the scale of investment in human capital.

Our studies confirmed the strong association between the complexity of development paths and examined cities' populations ($r−P$ = 0.548; p < 0.001). The results from the path complexity research identified simple paths in 17 towns in 2020. Most of them (15 units) were small towns, of which nine had a population below 5,000. The group of cities with simple paths also included 2 medium-sized units. In this group of cities, one additional development sub-path was developed in addition to the basic sub-path. In 13 cases, it was an industrial sub-path. In seven of these cities, intensive industrial development began in the pre-World War II period. In the four remaining cities, other types of sub-paths developed: administrative (Pajęczno), transport (Krosniewice), health (Warta), and leisure and tourism (Wolbórz). The simple type of development path was characteristic primarily of small towns and centres whose

establishment was related to 19th-century industrialisation (Aleksandrów Łódzki, Konstantynów Łódzki, Ozorków).

Compound paths were identified in 13 towns. This group included 11 small cities and two medium-sized cities. Three sub-paths were observed in six units, while in the remaining seven towns, only two sub-paths were identified. An industrial sub-path has developed in each city, an administrative sub-path in six units, also in six units a scientific and research sub-path. In five small towns, a leisure and tourism sub-path developed in the post-war period (Kamieńsk, Rzgów, Stryków, Sulejów, Uniejów).

Multiple compound paths consisting of at least four sub-paths were found in 13 towns (11 units were medium-sized towns). Multiple compound paths were also defined in two small towns (Tuszyn and Łęczyca, Table 2). The most extensive development path with five sub-paths was observed in the cities of Kutno, Łowicz, Piotrków Trybunalski, Skierniewice, Tuszyn, and Zgierz. Each of the cities in this group has developed an industrial sub-path. In 12 centres, an administrative, and scientific and research sub-paths were developed. A cultural sub-path was identified in nine cities. Leisure and tourism (two cities), health (two cities), and transport (six cities) sub-paths also appeared.

In the first period of our analysis, between 1945 and 1989, 28 towns changed their development strategies and expanded the existing specialisation with new sub-paths. Other changes took place between 1990 and 2020, when as many as 37 towns followed a reactive path. Interestingly, one of the towns, which had already exhibited a reactive path in the preceding period, changed the type of development path to a self-reinforcing one. It can be pointed out that the development paths formed in the cities studied were characterised by high durability. The established sub-paths were rarely closed, but at the same time it can be indicated that they stagnated, neither strengthened nor weakened.

Table 2. Types and complexity of development paths in the examined towns and cities of the Łódź region.

Period of time	Complexity of development path			Type of development path	
	simple	compound	multiple compound	self-reinforcing	reactive
1946–1989	38	5	0	15	28
1990–2020	17	13	13	5	38

Source: own compilation.

Durability of development paths: Correlation between human capital and types of development path

In each case, we observed a statistically significant dependence between the town's size, measured by population, and the institution's presence index. In subsequent years of the analysis, the strength of these dependencies increased in each of the studied areas (the value of coefficients in the last analysed year 2020: institutions of culture: $r-S = 0.86$, $p < 0.001$; scientific and research institutions: $r-S > 0.71$, $p < 0.001$; health care, and tourist and leisure institutions: $0.51 < r-S < 0.70$, $p < 0.001$).

In order to identify the durability of human capital-determined growth, we prepared hypothesis H1. To verify it, we checked firstly if the town's and city's demographic growth rate impacts the choice of the type of path. The analysis conducted using the GRETL package (Gnu Regression, Econometrics and Time-series Library, v. 2021a-64; https://gretl.sourceforge.net/) allowed us to conclude that there is an association between the type of development path and the average rate of demographic growth measured in selected periods (Pearson's chi-squared test = 14.9105; 3 degrees of independence, p-value = 0.00189479). The strength of the association measured with Cramer's V contingency measure is 0.34. Secondly, we checked if the size of a city's population determines the choice of the type of development path. We also found here an association (Pearson's chi-squared test = 20.4299; 3 degrees of independence, p-value = 0.000138247). The strength of association measured with Cramer's V contingency measure is 0.40. Thirdly, we checked if the complexity of a path determines its type. We concluded that the complexity and type of path are dependent (Pearson's chi-squared = 23.7388; 2 degrees of independence, p-value = 7.00128e-006). The strength of association measured with Cramer's V contingency measure is 0.43.

In conclusion, there were no grounds to reject hypothesis H1 which states that embedded human capital (identified by the rate of demographic growth and the population living in a particular region) determines the choice of the reactive path. Neither are there grounds to reject the hypothesis that the degree of complexity of a path determines its reactive type. This fact increases the likelihood of the reactive path being chosen and the durability of growth processes linked with it. However, we must bear in mind that historical-evolutionary analysis allowed us to conclude that in each city covered by the study, the reactivity of the path was caused by a strong impulse that created circumstances, in which the self-reinforcing model pursued so far had to be changed. Thus, most frequently, the current 'more' durable development model (which concerns cities based on the reactive development path) was induced not through evolution but rather through rapid changes. On the other hand, maintaining the reactive path stabilises with the increase in the level of complexity of the development paths and the territorialisation of processes connected with human capital.

Discussion and conclusions

We positively validated the hypothesis that in a time dominated by multi-dimensional globalisation processes, human capital evolves and, at the same time, is subject to internationalisation and territorialisation. Interestingly, when the value and mobility of human capital increase, it tends to seek specific places in which it gets embedded. This makes it a crucial component of territorial capital, which is a decisive force that shapes local development processes – urban development paths.

According to Martin and Sunley (2010: 67–68), there are two ways, in which the path dependence concept can be used: to explain the evolution of a particular industry, technology, or institution within a particular location, or through a particular location (region or city). In the first case, local factors that initiate the path are identified together with the mechanisms responsible for path reinforcement in a given location. In the second case, less attention is paid to industry development in a given location, and studies focus on examining how a given industry developed in many regions (locations). An assumption about the absence of spatial determination is made as it is argued that many regions have similar general conditions, and the dominance of any of them is difficult to predict. Our research was based on the first analytical approach since the second one

seems less likely from the viewpoint of current innovation theories that make reference to the deterministic role of the innovation milieu. This approach is not the subject of our consideration. Nevertheless, the analysis we conducted at theoretical and empirical levels helped us to accomplish our research aims.

We identified the directions of the evolution of human capital regarding the form, conditions and possibilities of its territorialisation. Knowledge is essential from scientific and pragmatic perspectives (i.e. business practice). Human capital is quickly internationalised; however, it tends to concentrate in locations that exhibit specific social, institutional, spatial, and economic characteristics. Generally speaking, we may observe that the capital of a similar class tends to cluster, which does not mean it is internally heterogenic.

Examining the collected data also allowed us to specify the dependence of human capital on the type and degree of complexity of development paths in individual towns. The research allowed fulfilling the aim of the study and verifying the hypothesis. To sum up, it can be stated that:
– the analysis of urban development paths allows us to conclude that the territorialisation of human capital affects the durability of urban development processes,
– cities with reactive paths demonstrate a more durable development path.

Territorialisation determines the benefits of location, not only for companies but also for residents. The consequence of embeddedness in a place is building relationships and institutions that constitute the development process framework. The alternative costs of losing access to these relationships and institutions are also barriers to migration processes. Thus, they positively impact the relative durability of development processes in relation to human capital. In other words, numerous studies prove that human capital is a factor of the region's competitiveness. However, increasing mobility (instability) may also trigger development crises more often. Our research proves that human capital, while being a development factor, also positively impacts the resilience of cities.

There are no grounds to reject the hypothesis that territorialised human capital directs urban development strategies towards choosing reactive paths. Neither are there grounds to reject the hypothesis that the degree of complexity of a path also determines whether a reactive type of development path is chosen. We also need to stress that all these associations and dependencies are statistically significant, although their strength is relatively low or moderate. This prompts us to continue seeking other ways of exploring an important and pertinent issue: does human capital territorialisation impact the durability of urban development processes? It is not apparent whether, by investing in internationalised human capital, a territory fosters its competitive potential and comparative advantages only temporarily or over a long period.

Author's contribution

ZP: conceptualisation, data curation, formal analysis, investigation, methodology, project administration, resources, software, validation, writing – original draft; JA: conceptualisation, data curation, formal analysis, investigation, methodology, project administration, resources, software, validation, visualisation, writing – original draft.

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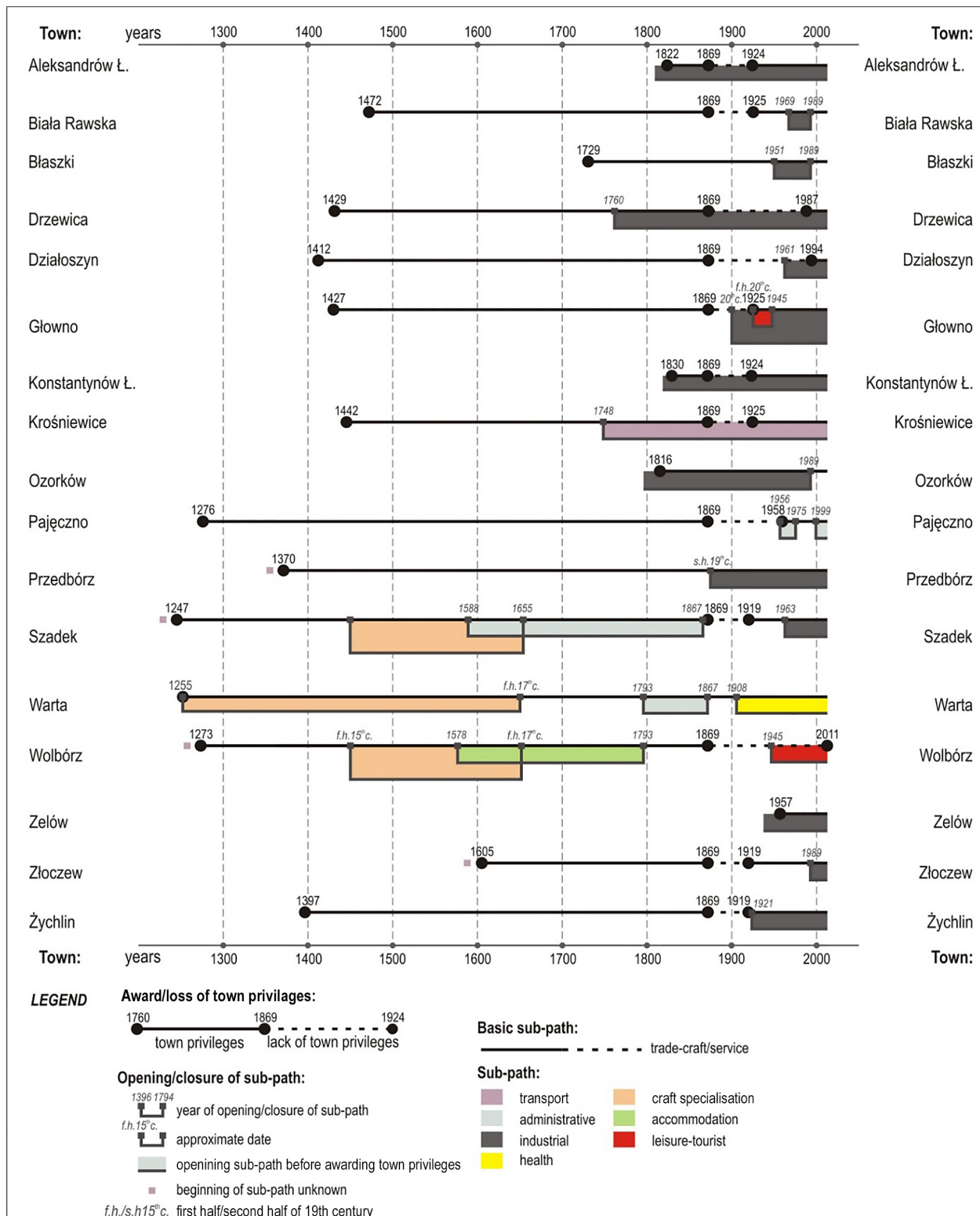**Appendix 1: An example of the development path for the selected town of Ozorków**
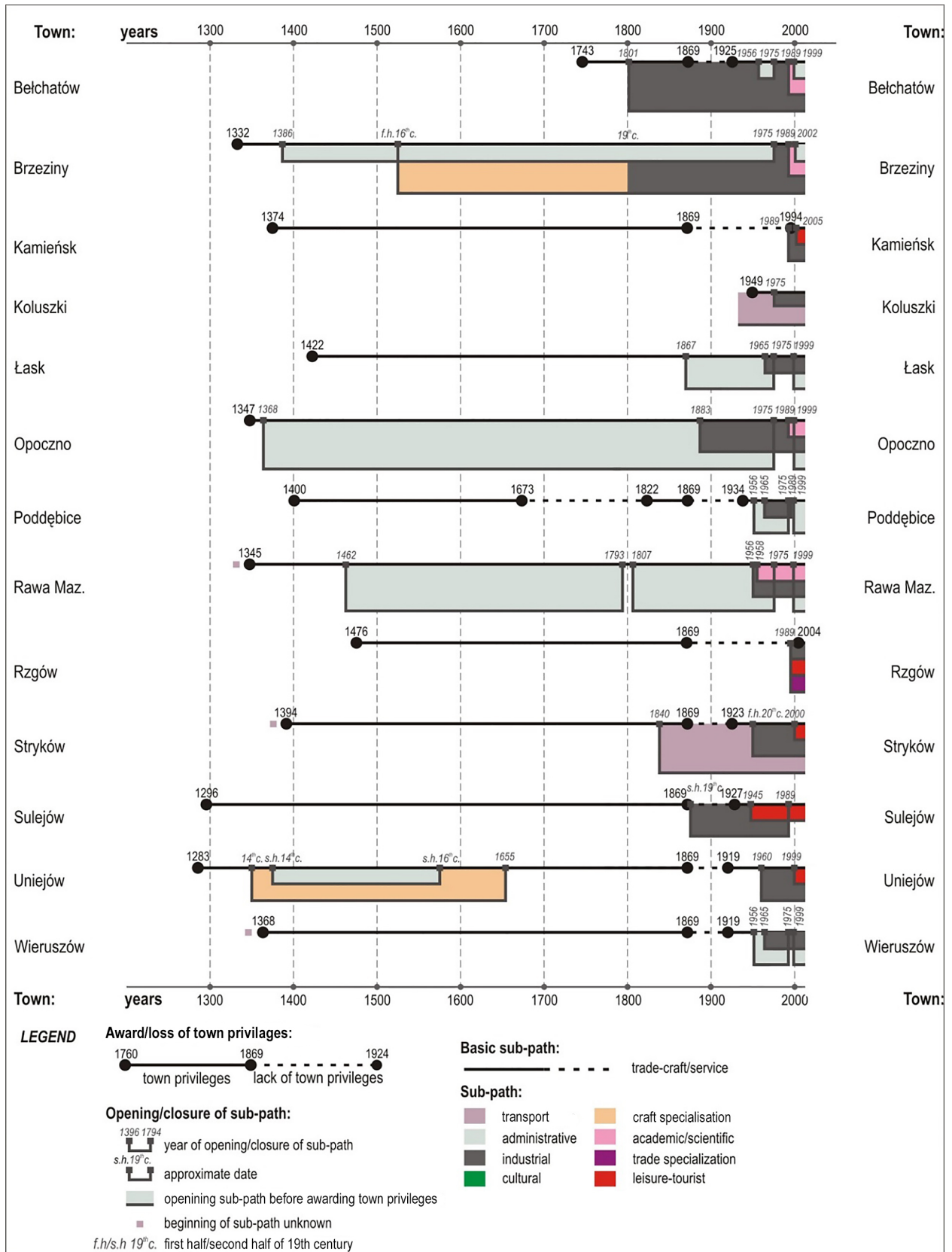
OZORKÓW - simple path

1) years to 1945

2) years 1945-2017
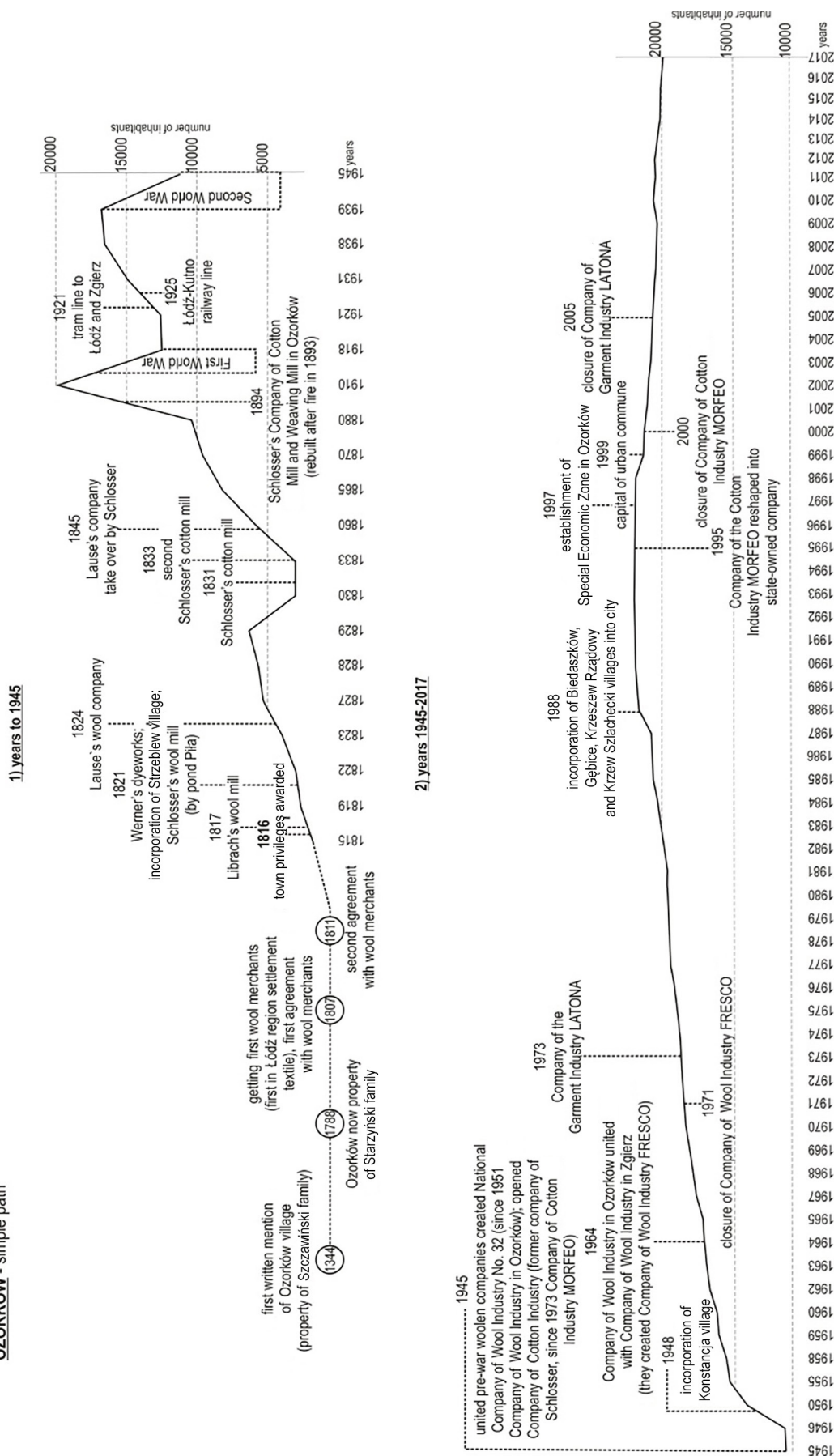
Source: authors' own compilation based on Górny, Łuczak 2009, Rosiak 1963, http://www.umozorkow.pl/ [entry: 05.03.14].

Appendix 2: Towns and cities based on the level of complexity of path development: a. simple paths, b. compound paths, c. multiple compound paths

Town: years 1300 1400 1500 1600 1700 1800 1900 2000 Town:

Aleksandrów Ł. — 1822 1869 1924 — Aleksandrów Ł.

Biała Rawska — 1472 — 1869 1925 1969 1989 — Biała Rawska

Błaszki — 1729 — 1951 1989 — Błaszki

Drzewica — 1429 — 1760 1869 1987 — Drzewica

Działoszyn — 1412 — 1869 1961 1994 — Działoszyn

Głowno — 1427 — f.h.20ᵗʰc. 1869 20ᵗʰc.1925 1945 — Głowno

Konstantynów Ł. — 1830 1869 1924 — Konstantynów Ł.

Krośniewice — 1442 — 1748 1869 1925 — Krośniewice

Ozorków — 1816 — 1989 — Ozorków

Pajęczno — 1276 — 1869 1956 1958 1975 1999 — Pajęczno

Przedbórz — 1370 — s.h.19ᵗʰc. — Przedbórz

Szadek — 1247 — 1588 1655 1867 1869 1919 1963 — Szadek

Warta — 1255 — f.h.17ᵗʰc. 1793 1867 1908 — Warta

Wolbórz — 1273 — f.h.15ᵗʰc. 1578 f.h.17ᵗʰc. 1793 1869 1945 2011 — Wolbórz

Zelów — 1957 — Zelów

Złoczew — 1605 — 1869 1919 1989 — Złoczew

Żychlin — 1397 — 1869 1919 1921 — Żychlin

Town: years 1300 1400 1500 1600 1700 1800 1900 2000 Town:

LEGEND

Award/loss of town privileges:
1760 — 1869 ---- 1924
town privileges / lack of town privileges

Opening/closure of sub-path:
1396 1794 year of opening/closure of sub-path
f.h.15ᵗʰc. approximate date
opening sub-path before awarding town privileges
beginning of sub-path unknown
f.h./s.h15ᵗʰc. first half/second half of 19th century

Basic sub-path:
—— - - - - trade-craft/service

Sub-path:
transport — craft specialisation
administrative — accommodation
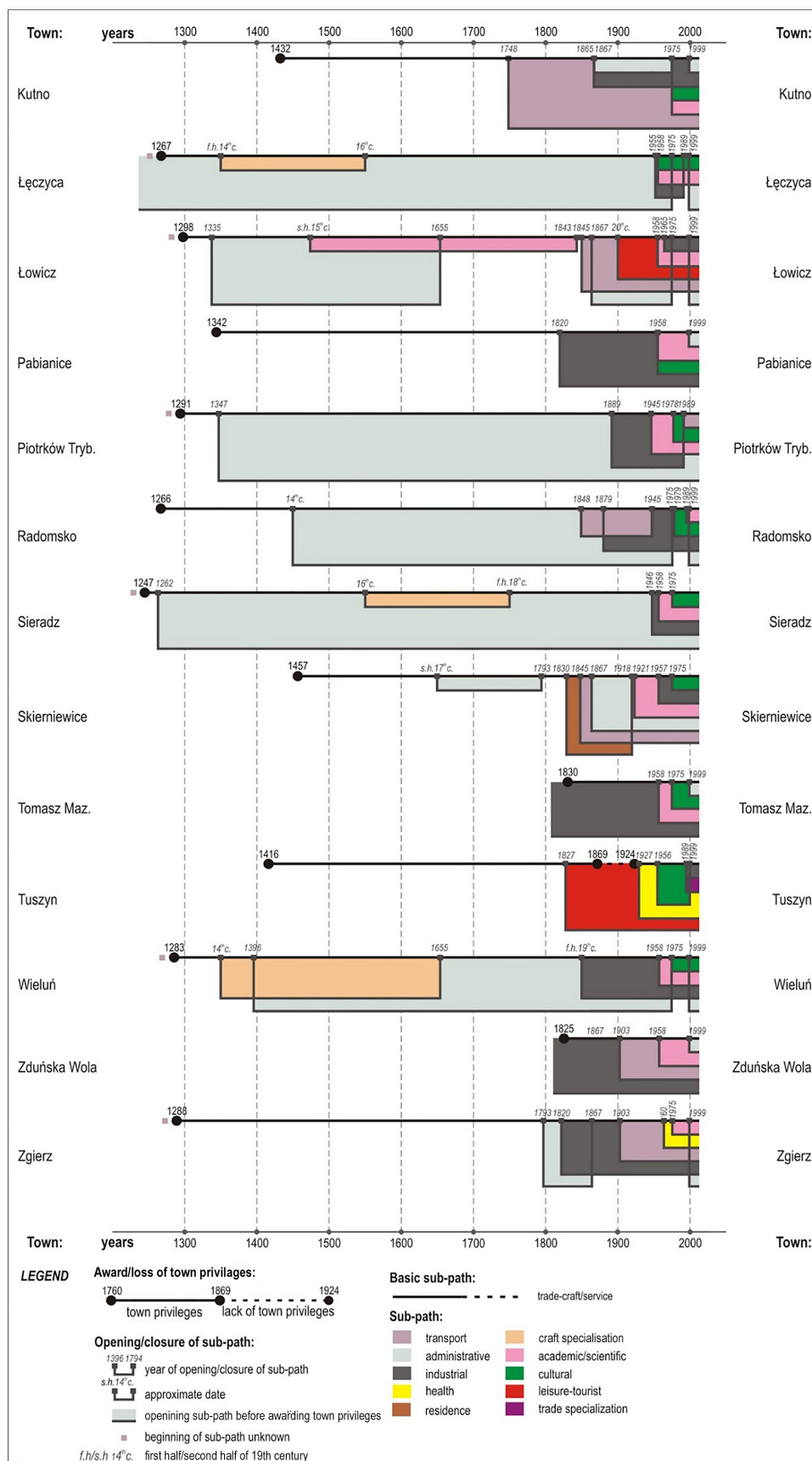industrial — leisure-tourist
health

a. Simple paths.
Source: own compilation.

b. Compound paths
Source: own compilation.

c. Multiple compound paths
Source: own compilation.