




The analysis of human capital in the context of local economic development

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Abstract

Motivation: The study of local economies has become a significant part of the theoretical and practical approach to economic research. It is important to define variables used for modeling, so the aim of this paper is to identify human capital as the determinant of local economic development. While studies are often conducted on the basis of research material describing a given unit of territorial self-government, the methodology can be applied more broadly.

Aim: The aim of the paper is to define the key elements of human capital, which can be used for modeling economic development in the local context. Local development is influenced by a number of factors, such as physical capital, human capital and natural resources, but in this paper we focus both on the analysis of the variables describing human capital both at the moment of examination and of those which will affect its quality in the future.

Results: The research findings reveal that human capital in Ustka was subject to significant changes in the period under study and its quality is determined by the economic de-



velopment of this commune. What is also important is the fact that the variables describing human capital indicate the improvement in the quality of this capital in this territorial unit. Further research into local development should thus take into consideration this significant aspect of economy.

Keywords: economics; regional economics; economics of development; human capital
JEL: O10; R58; R11

1. Introduction

In the analyses of the determinants of economic development on the national, regional and local scale, a lot of importance is attributed to human capital (Manca, 2012). Authors seem to agree that the significance of human capital in economic development and growth refers both to its quantitative and qualitative characteristics (Acemoglu, 2012, p. 2; Faggian et al., 2019). There is no doubt, however, that it is quite difficult to examine the qualitative aspects of human capital and that the effects of investment in this capital are not easy to measure and usually long-term. Yet the influence of human capital on the pace of economic growth cannot be denied. It should be pointed out that human capital is broadly defined as the outcome of investment not only in education, but also in the improvement of the qualitative features of human resources, i.e. investment in health, environmental protection and culture (Di Cataldo & Rodríguez-Pose, 2017).

It is thus safe to say that human capital is the sum of different investments in people. These investments translate into human economic activity and the basic implication of human capital is that economic benefits from them include not only the growth of the productivity of individuals, but also the increase in the productivity and wealth of the community that these individuals live in (Schuler, 2001, p. 5).

The aim of the article is therefore to define the role of one of the factors influencing local development, i.e. human capital. It was assumed that human capital and its changes contribute to an increase in the dynamics of economic development of the examined commune.

In order to accomplish this goal, the local development model was used. Its important element is the part dedicated to the study of the role of human capital in economic growth and its characteristics in the analyzed example. In the paper, statistical material mainly from the Local Data Bank (2021) was used, but also from other sources of local business information. The study covers the area of the urban commune of Ustka, a small town with the status of the seaside health resort, located in the Pomeranian Voivodeship, in an important area from the point of view of environmental protection, the so called: “Green ring of the Baltic”. It should be emphasized that Ustka is a territorial unit of supra-local character, being a derivative of its Baltic location and the resulting centuries — old traditions of maritime economy (fishing and fish processing,

shipbuilding industry), climatic conditions with healing properties and attractive opportunities for recreation, tourism and health.

The time range adopted in the study is the years 2004–2017, which were selected both for substantive reasons, i.e. from the beginning of Poland's membership in The European Union, and because of the availability of statistical data.

The dedicated model is based on statistical methods, such as the analysis of correlation and regression and multidimensional comparative analyses, with the application of the Hellwig method. The selected methodology allowed us to come up with the synthetic presentation of human capital in economic growth in the commune under study.

The first part of the paper includes a review of economic literature concerning the issues of economic development and human capital as its determinant. In the second part, the research method was discussed in detail, and in the subsequent section the research findings and the possible application of this local economic development model was presented. The final part of the paper includes synthetic conclusions.

2. Literature review

Historically, the first attempts to formulate the definition of the concept of human capital were made in the works of well-known representatives of economic studies, such as: Becker (1964), Schultz (1961), or Mincer (1958). In recent times, the issue has also been addressed by, among others: Goldin (2016) or Bouchard (2008).

It is not an easy task to measure human capital because of the heterogeneity of this economic category. The amount and quality of human capital in economy depends on a number of factors. In one approach, the role of improving the quality of human capital by investing in it is studied, having in mind quite a significant time horizon between the costs incurred and the real growth of the quality of this capital (Goldin, 2016). Very often, the issue of the quality of human capital in the regional and local context is addressed (Siński, 2018). Broader studies from the macroeconomic and international perspective are also conducted (Knapińska & Woźniak, 2016).

It should be indicated that in the study of long-term economic and social effects in the countries of Central and Eastern Europe, as part of the project — *The European Human Capital Index: the challenge of Central and Eastern Europe* — in which the role of human capital in economic growth and social prosperity was examined, the authors distinguished four areas of the analysis of human capital (Ederer et al., 2007, pp. 8–17):

- human capital endowment, the cost of all types of education and training per person active in the labour force;
- human capital utilisation, measured as the percentage of the labour force in the whole population and including the inter-generational component showing that different age groups have different capital resources;

- human capital productivity, a country's overall GDP divided by the number of people employed in the economy;
- demography and employment, an estimation of the number of people who will be employed in 2035.

The economic growth effects of human capital in cities, particularly on employment and productivity growth, are well demonstrated in various theoretical or empirical studies (Lucas, 1988; Moretti, 2004; Rauch, 1993). In other studies authors tried to identify the relation between human capital and productivity and quality of life (Shapiro, 2005). Shapiro (2005) used data on growth in wages, rents, and house values, than calibrated a neoclassical city growth model and found that roughly 60% of the employment growth effect of college graduates is due to enhanced productivity, the rest — according to his study — being caused by growth in the quality of life.

The size of human capital resources is one of the basic sources of economic growth. The more people are employed and the longer their working time is, the more goods they are able to produce. As the measures describing human capital resources, the indicators of human potential (as the outcome of the demographic situation) and the degree of professional and economic activity of the population were adopted (Mincer, 1981; 1984). In literature is also known the simplest model of schooling decision in partial equilibrium, which illustrate the main trade-offs in human capital investments (Acemoglu, 2009, p. 362). These investments can provide to the improvement of quality of human capital.

The amount of potential human capital resources is first of all influenced by the size of population actually inhabiting a given territory, with the real potential of resources determined by the number of people of working age, able to work and ready to take up a job (Czarnik et al., 2011).

The role of human capital in generating the volume of production and economic growth can be expressed by way of the following equation:

$$Q = f(A, [E \times P\gamma], K, X). \quad (1)$$

According to this equation, human capital (E) enters the aggregate production function by augmenting labour, which is a function of the level of population (P) and the aggregate labour force participation rate (γ). In practice, human capital is measured as an index of efficiency units labour. Aggregate output (Q) is also altered by other inputs, such as the stock of capital (K), resources (X), and the level of technology (A) (Goldin, 2016).

The goal of local economic development mapped by the model proposed in the paper, is to achieve the highest possible level of development. This level would be possible within the limits resulting from the state of capital—in this case it is only the human capital—and the ability to stimulate development through the influence by factors determining the level of this capital in terms of resources and quality. It is assumed that the effects of local economic development defined

in the model as a long-term process of changes taking place in the economy, are measurable.

The variables describing the affluence and social inequalities of the inhabitants of the studied commune were adopted in the model as the components of the general level of Local Economic Development (LRG). It was assumed that the development of local economy is not an end in itself, and the most important are the effects of its impact on the standard of living of the inhabitants. The role of human capital in the understanding of economic development was also emphasized by Kołodko (2020, p. 293), referring to macroeconomic aspects, but at the local level it is also an important component.

3. Methods

The selection of partial diagnostic variables proposed as features describing the basic components of the model was made in such a way that they should: represent various aspects of the phenomenon being explained; concern only the essential aspects and properties of the analyzed phenomenon; be in a cause-and-effect relationship with the explained phenomenon; be unambiguously and strictly defined; be measurable variables representing documented sources of data; be a complete and accessible set for all examined objects in the period 2004–2017 (Józefowski & Młodak, 2017; Młodak, 2014).

In the research procedure, the variables, which consisted of the most important factors and measures describing human capital, were verified. After that, the analysis of model estimation was interpreted (Wooldridge, 2010). The next step was to conduct a preliminary analysis of the statistical material in order to eliminate quasi-constant variables, which showed the inconsistency of descriptive characteristics or independent variables which duplicated information (Wooldridge, 2017, p. 63). After that, was made the calculation of the critical values of the correlation coefficient of independent variables for the assigned relevance level 0.05 and for $n-2$ degrees of freedom, where the number of observations is $n=14$, which is $r=0.49$ (for Student's T-test 1.9712). To examine the mutual relationship between the components describing human capital, it the regression analysis was conducted, covering the estimation of the structural parameters of the model with the use of the Classical Least Squares Method; the study of the degree of coincidence (adjustment) of the model with the empirical data, through the analysis of the coefficient of determination R^2 , informing to what extent the variation of the dependent variable was explained by the model; the verification of the hypothesis of the relevance of the model's structural parameters with the application of Student's T-test; checking value p treated as the individualized level of relevance. In the further model, the research procedure, based on regression models, included the analysis of: the influence of the selected determinants of the level of human capital and relations between the variables describing capital and conditions of development

and the synthetic variable describing the level of local economic development (as the dependent variable).

Because of the complex character of local economic development, the multi-dimensional comparative analysis (MCA) was used as a research tool for measuring and evaluating it.

As a result of the normalization of the synthetic indicator, consisting in the transformation of the measures of Euclidean distances so that they would assume values from the range (0;1), it was possible to estimate it because the growth of the measure corresponded with the more favourable tendency in the analyzed phenomenon. If it is not possible to clearly identify links between the particular factors of development, i.e. when it is not justified to identify dependent and independent variables, their relationship is mutual.

At the next stage, we examined the relationships between partial synthetic indicators and the synthetic measure of the level of local economic development (LRG) with the application of the coefficient of significance, used for measuring the relative importance of partial synthetic indicators (being independent variables here) in explaining changes of the overall synthetic measure of local economic development (dependent variable), defined as follows:

$$b_i = \frac{\bar{x}_i}{\bar{y}} a_i, \quad (2)$$

where:

\bar{x}_i — arithmetic mean of independent variable X_i ;

\bar{y} — arithmetic mean of dependent variable Y ;

a_i — value of the assessment of the structural parameter.

The last phase of the research procedure consisted of conclusions. the assumption that the implication of the use of quantitative criteria in the study will be the objectivization of analyses and conclusions was adopted.

Taking into consideration the above findings and the availability of statistical material concerning the examined commune of Ustka, the variables describing human capital resources proposed in the model include:

- total size of population ($Y(kl)_1$);
- percentage of people of working age in the overall population ($Y(kl)_2$);
- demographic burden indicator ($Y(kl)_3$), being a destimulant;
- the number of people working in business entities with 10 or more employees ($Y(kl)_4$);
- professional activity indicator ($Y(kl)_5$).

Factors determining the size of human resources include, first of all, the demographic dynamics indicator ($X(kl)_1$), equivalent to the growth of population (births minus deaths in particular year) and the migration balance ($X(kl)_2$). Especially the former variable has been negative in Poland for years. The migration balance, in turn, assumes different values depending on the “force of attraction” of the examined settlement unit.

What is the most frequently used measure of the human capital quality is the population's education level. It is assumed here that the higher the level of education is completed by an individual, the greater their skills determining the quality of human capital. However, reliable data on formal education of the population come from the censuses (made every 10 years) which makes it possible to analyze changes in the population structure by education in the period between the censuses.

As a consequence the proposed qualitative measures were limited only to those for which data were available:

1. Councilors' education level, measured as the percentage of councilors in their total number ($Y(jl)_1$), it is justified by the fact that, city councilors influence by their decisions on the level of local development. By animating economic life, they are the social group that should demonstrate appropriate competences, especially in the context of recognizing needs and obtaining funds to meet them.
2. Gross enrolment ratio, the ratio of the number of students on a particular grade level (e.g. high school) to the total population in the age corresponding to this level. In the case of analyzed commune, however, this indicator is not useful in the study, because it exceeds 100% in all years, which results from the fact that students from neighboring communes attend primary and secondary schools located in a given commune.
3. Pre-school enrolment ratio, calculated as the percentage of children in the age 3–7 in kindergarten education ($Y(jl)_2$), with proviso that preschoolers are a potential workforce with an even longer duration than students.
4. the average score in high school tests, illustrating the level of educational attainment ($Y(jl)_3$). The external examinations conducted in the years 2002–2019 performed a diagnostic function, constituting one of the indicators of education effectiveness and a evaluative function, being the basis for the assessment of the education process at school.
5. The number of primary school students per one computer ($Y(jl)_4$), indirectly indicating changes in possibilities of preparing students to use information technology in the future.
6. Readership level (calculated as the number of books borrowed from libraries per one inhabitant) ($Y(jl)_5$), identifying the interest in raising the level of knowledge acquired largely outside the school system. However, one should be aware of the informational limitations of this indicator, resulting from not taking into account such sources of knowledge like: Internet, television, specialist press and knowledge acquired through the interpersonal contacts and experience.

As qualitative measures, we also proposed indicators related to the participation of residents in the cultural life of the commune, assuming that it has a positive impact on the value of human capital. In the paper, the following measures of human capital quality were used: the number of people attending cultural

events organized by municipal cultural institutions ($Y(jl)_6$), such as concerts, exhibitions, theatrical performances, courses (language, arts, etc.).

In the evaluation of health condition it was assumed that the healthier people are, the longer they live — one might suppose that the average life expectancy could be an appropriate qualitative measure. However, due to the lack of data on the level of commune, it could not be used. In this model, we proposed a variable of “the dynamics of the median of inhabitants’ age” ($Y(jl)_7$) calculated on the basis of information from the Local Data Bank (2021) concerning the number of residents according to five-year age groups (with the youngest group in the age 0–5 and the oldest with people aged 50 and older).

Investment in human capital, identified with the factors that could affect its qualitative level, was estimated with the use of the following measures:

- local government’s expenditure on education per one inhabitant ($X(jl)_1$). It was assumed that qualifications developed in the process of the enrolment of education as the investment in the education of students (including adults) and kindergarten children increases, which reflects the potentially better conditions for acquiring knowledge;
- local government’s spending on health care per one inhabitant ($X(jl)_2$), treated as investment in human capital. In this aspect, health is perceived to be a permanent capital resource, which is subject to depreciation with time, but could be enlarged or renewed through adequate outlay (Rój, 2020). The determinants of the qualitative dimension of human capital also include:
 - the number of cultural events held annually by municipal institutions ($X(jl)_4$);
 - the size of the book collection in the Municipal Library ($X(jl)_3$), assuming its influence on the number of books borrowed.

With regard to the variables describing local development in this study, the annual values obtained from the Tax Office in Słupsk are proposed as the basis for an indicator at the commune level that is substitute for GDP, which is most often used in the comparative macroeconomic analysis of economic development:

- income of individual persons, inhabitants of Ustka, declared in the PIT settlement, increased by the value of municipal social benefits and expenditure on family policy, per the number of payers ($Y(lrg)_1$);
- income of legal persons with their seat in Ustka, declared in CIT settlement, per the number of entities ($Y(lrg)_2$).

Income indicators used in the model largely reflect the level of welfare of the population, without providing any information about the structure of the wealth of the population, i.e. income inequalities. Considering the most popular one for measuring inequality, the Ginie’s index is not available at municipal level. The information gap in this aspect is partially filled by the poverty rate ($Y(lrg)_3$), calculated as the share of the number of inhabitants covered by local government social welfare in the total population. On the other hand, taking into consideration the statement that poverty in Poland primarily threatens people who are unemployed (apart from people living on unearned sources

and large families) the rate of unemployment ($Y(lrg)_4$), calculated as a share of the registered unemployed in the number of inhabitants in working age was used, to measure the level of economic development. It was recognized that the position on the labour market is one of the most important factors determining the material and social status of a person and their family. It should also be noted that the statistical data on registered unemployment do not take into account the phenomenon of the “shadow economy” and people working illegally.

It should be indicated that in order to avoid the effects of inflation, all variables in the form of income and expenditure were presented in real terms in the model, i.e. they were calculated using prices for 2004.

The mutual relations between the variables describing human capital and the level of local economic development are presented in Scheme 1.

The dedicated nature of the model resulting from the use of the case study method in its construction does not limit the possibility of its modification by adding further types of capital, e.g. economic and natural, and, consequently, extending the matrix diagnostic variables with indicators describing the added components.

4. Results

The list of potential variables describing human capital resources in the quantitative dimension is presented in Table 1.

Because only for two characteristics: the demographic burden indicator and the number of employed people, the coefficients of variation reached the threshold value, the other variables were eliminated, marked with low variation (between 1.9% and 5%) from the further research procedure. It should be pointed out, however, that the variables qualified for further analyses ($Y(kl)_3$ and $Y(kl)_4$) also had low differentiation.

Chart 1 shows changes in the demographic structure of the population of Ustka, among which only the demographic burden indicator $Y(kl)_3$ will be subject to further analysis. As the presented data reveal, the ratio of post-working age population to the group of people of pre-working age looks particularly unfavourable from the perspective of labour resources. The variables determining human capital resources (kl) in the quantitative dimension are presented in Table 2.

The indicators from Table 2 assumed mainly negative values, which, consequently, led to a decrease in the size of the population of Ustka in the analyzed period of 14 years by 3.7%.

As Chart 2 showed the positive population growth only sporadically (years 2005, 2008–2010). Similarly, the positive migration balance was recorded only in 2010, while the negative value of the balance was determined by internal migration as the balance of foreign migration for the years 2004–2017 was positive (39 people came from abroad, while 19 people emigrated). Changes in the pop-

ulation's status, stemming from population growth and migration were adjusted with short-term temporary stays.

To verify the strength of relationships between the characteristics of human capital resources (the demographic burden indicator, the size of working population) and the determinants of the volume of resources (population growth, migration balance), the correlation coefficients were used.

The coefficients of linear correlation presented in Table 3 reveal that:

- the critical value occurred for none of the pairs of features;
- the applied variables compose the system of consistent characteristics, because the coefficients of correlation between stimulants are positive, while they are negative between stimulants and destimulants ($Y(kl)_3$).

As Table 3 shows, vectors R_n of the correlation coefficients of each of the dependent variables were as follows:

- for the demographic burden indicator ($Y(kl)_3$) vector $R(kl)_3 = (-0.79; -0.37)$;
 - for the number of working people ($Y(kl)_4$) vector $R(kl)_4 = (0.75; 0.44)$;
- thus, the correlations between the population growth and the demographic situation, and between the population growth and the number of working people can be deemed as relevant.

The data from Table 4 allow to evaluate the adjustment of the model, measured with coefficients of determination, as moderate. At the same time, it was observed the significant relevance of the result of the study — value $p < 0.01$.

Potential variables describing human capital quality (jl), are presented in Table 5. Apart from the measures listed in Table 5, it has been founded that another relevant factor influencing the quality of human capital in future was the scale of foreign language teaching in schools. Due to the lack of data for years 2004–2007 (Table 6), this indicator can only serve the supplementary role.

Similarly, the dynamics of the median of inhabitants' age ($Y(jl)_7$), which should indirectly reflect their health condition, may be additionally illustrated by the graphic representation of the population structure according to age at the beginning (2004) and end (2017) of the research period. Chart 3 is the combination of two adjacent histogram of age distribution. It should be noted that the histogram for 2017 is the reflection of the regressive type of structure (narrow pyramid base and wide top), which is typical of ageing societies.

In the further research procedure, all variables except for “the average score at junior high school final examinations” ($Y(jl)_3$), which was marked with a low degree of variation (4%) were used. As factors affecting the quality of human capital the variables presented in Table 7 were adopted.

The study of correlations of variables describing human capital and affecting its level in the qualitative aspect (Table 7) indicates the need for the further verification of the set because of the required coincidence of features (relevance of characters) since all indicators have the character of stimulants.

The data in Table 8 show that the relationships of such dependent variables as “the percentage of councillors with higher education in the City Council” ($Y(jl)_1$) and “the number of books borrowed from a library per one inhabitant”

($Y(jl)_5$) are marked with the lack of coincidence, resulting from their exclusively decreasing value and different (predominantly increasing) values of the other variables in the research period. Thus, they need to be ignored in further analyses. In turn, the non-coincidence of characters of all (except for the abovementioned ones) variables with regard to “the number of primary school students per one computer” ($Y(jl)_4$) results from the fact that it is a destimulant (the fewer students, the better).

As Table 8 shows, vectors R_n of the coefficients of correlation of each dependent variables with the potential independent variables, after eliminating ($Y(jl)_1$, $X(jl)_3$, $X(jl)_5$) from the set of dependent variables, were as follows:

- for the pre-school enrolment ratio ($Y(jl)_2$) vector $R(jl)_2=(0.49; 0.44; 0.79)$;
- for the number of school students per one computer ($Y(jl)_4$) $R(jl)_4=(-0.31; -0.60; -0.39)$;
- for the number of participants of cultural events ($Y(jl)_6$) $R(jl)_6=(0.15; 0.35; 0.71)$;
- for the dynamics of the median of the commune inhabitants’ age ($Y(jl)_7$) $R(jl)_7=(0.71; 0.77; 0.76)$.

The analysis of correlations of the selected factors with the level of human capital quality requires not only using the value of the presented vectors ($R(jl)_2$, $R(jl)_4$, $R(jl)_6$, $R(jl)_7$) as the base, but also adopting the substantive approach to relationships between variables. Taking this into account, the high correlation (0.79) between the pre-school enrolment ratio and the number of cultural events must be deemed as accidental, not reflected in reality.

It must be noted that there is a similar approach to the relationship between the number of pupils per one computer and health care spending (–0.60). In turn, the influence of the commune’s educational expenditure on the percentage of kindergarten kids in the overall population of children aged three to six is significant (0.49). The direct connection between the intensity of the commune’s cultural life and the number of cultural events organized by municipal institutions is logically justified (0.71). What is a bit puzzling are the factors affecting the residents’ life expectancy, estimated in the paper in the form of “the dynamics of the median of the inhabitants’ age.” Among the analyzed variables, only the relationship with health care spending (0.77) can be considered obvious, while the correlation with expenditure on education (0.71) is significant only to a certain degree. It is difficult to treat the number of cultural events as the factor prolonging life expectancy, so it was ignored in the analysis.

The results of the regression analysis for the determinants of the level of indicators — the number of participants of cultural events and the median of age, the relevance of which was verified positively with the application of Student’s T-test — is presented in Table 9.

As the data in Table 9 show, the correlations that can be deemed relevant include the influence of the number of cultural events ($X(jl)_4$) on the number of their participants ($Y(jl)_6$) and the impact of health care spending ($X(jl)_2$)

and educational expenditure ($X(jl)_1$) on the inhabitants' health condition, estimated on the basis of the dynamics of their age ($Y(jl)_7$), with the average coincidence of model parameters measured with coefficients of determination.

The research procedure regarding the analysis of human capital was concluded with the generation of the synthetic measure of human capital (see Chart 4), the components of which include the standardized values of six variables: the number of people employed, the demographic burden indicator, the pre-school enrolment ratio, the number of students per one computer, the number of participants of cultural events, and the dynamics of the median of inhabitants' age.

Diagnostic variables describing the local economic development ($Y(lrg)_i$) proposed in the model are presented in Table 10.

The course of the curves illustrating, calculated cumulatively, the dynamics of PIT payers' income and the poverty and the unemployment rates, shown in Chart 5, allows to draw a conclusion about a clear improvement in the living conditions of Ustka residents in the final years of the analyzed period.

It should be emphasized that there is a very strong correlation between the income of PIT payers and the level of inequality measured by poverty rate and unemployment rate (correlation: -0.90 and -0.83). The impact of CIT payers' income on the level of the above-mentioned indicators, also at high level (correlation: -0.75 and -0.73 respectively), was less important due to the differences in the total amount of income PIT and CIT (see Chart 5 and Chart 6).

5. Conclusion

The analysis of the curve shown in Chart 7, which is a synthetic indicator calculated for the analyzed variables, leads to formulate the following conclusions:

- the very low value of the synthetic measure in 2007 was mostly influenced by a drop in the number of people employed to the lowest level in the research period, with the simultaneous decrease (as compared to previous years) of the number of participants of cultural events;
- another “collapse” in 2011 was mainly caused by “the participants of cultural events”, whose number dropped to the lowest level in the period under analysis and by the pre-school enrolment ratio, not exceeding 60% in the years 2011–2012;
- from 2015, the synthetic measure was more strongly influenced by the values of resource variables (the demographic burden dropped to its minimum level in 2017), which moved in the direction opposite to the direction of “qualitative” indicators, which, except for “the number of participants of cultural events” were the highest in 2017.

The summary of the research procedure for measuring the level of local economic development was the generation of its synthetic measure, the components of which are standardized values of wealth and social inequalities indicator (see Chart 7).

An additional study examined relationships between the resource (kl) and qualitative (jl) aspect of human capital (HC), generating partial variables synthetic for both dimensions, and then calculating coefficients of correlation with human capital as a whole. The analysis of vector $R(HC)=(r_{kl}; r_{jl})$ with values $(-0.19; 0.83)$ indicates the occurrence of a strong relationship with reference to the quality of human capital and its lack in the case of resources.

Regression analysis, the results of which are presented in Table 11, also indicate the quality of human capital as a factor strongly affecting the level of local development in the research period.

The presented analysis of human capital for the commune of Ustka may serve as the basis for further research into the local economic development of this entity. However, it should be emphasized here that the study of the role of human capital may concern both its influence on economic growth and, more broadly, on economic development. Both these categories are the subject of interest of the local government, which strives for increasing the level of GDP in the region and, in the long-term, for maintaining economic growth. The commune of Ustka is grappling with changes in the economic structure, which have similar roots as in other Polish communes (Wosiek, 2020). At the same time, however, we can often observe fluctuations in inhabitants' professional activity and population migrations, which have already been the subject of studies concerning other local units (Bieszk-Stolorz & Dmytrów, 2019; Pietrzykowski, 2019). Threats to development, and thus challenges for Ustka, include: the need to cope with the long-term negative social and economic effects of ageing of the society and the need to take steps to increase the attractiveness of settling in the city. In this context, the key is the implementation of investment program enriching the spa offer, addressed mainly to tourists coming to the city also outside the summer season.

Additionally, the stability of government in the region and in the commune is of great importance, that means undertaking the cohesive, long-term policy of regional development for this geographical area (Marks-Bielska et al., 2020).

In further research, the catalogue of variables affecting economic growth and development to include physical and financial capital, natural environment assets, conditions of the economic and legal environment, is worth extending as well as external surroundings, the element of which is, for example, the Covid-19 pandemic. Steps made in this paper may become a part of further research into local economic development.

There is no doubt that the tool for the analysis of factors describing human capital in the commune of Ustka can be used for studying other self-government units, also for examining this capital from regional, national and international perspective. However, a set of variables may differ because of the specific character of the economy, the demographic structure, the availability of statistical data, which may be a limitation to using the approach presented here. The tool and the approach, however, are universal and can be successfully used for other territorial units.

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Appendix

Table 1.
Human capital resources

Symbol	Specification	Measurement unit	Coefficient of variation (in %)
$Y(kl)_1$	total population	persons	1.9
$Y(kl)_2$	percentage of people of working age in total population	%	5.0
$Y(kl)_3$	demographic burden indicator	%	14.7
$Y(kl)_4$	number of employed people	persons	12.9
$Y(kl)_5$	coefficient of professional activity	%	4.5

Source: Own preparation.

Table 2.
Variables determining human capital resources

Symbol	Specification	Measurement unit	Coefficient of variation (in %)
$X(kl)_1$	demographic dynamics indicator (population growth)	persons	153.8
$X(kl)_2$	migration balance	persons	52.8

Source: Own preparation.

Table 3.
Correlation coefficients: human capital resources

Specification	$Y(kl)_3$	$Y(kl)_4$	$X(kl)_1$	$X(kl)_2$
$Y(kl)_3$	1.00			
$Y(kl)_4$	-0.49	1.00		
$X(kl)_1$	-0.79	0.75	1.00	
$X(kl)_2$	-0.37	0.44	0.27	1.00

Source: Own preparation.

Table 4.
The results of regression analysis: human capital resources

Correlation between variables		Assessments of model parameters		Standard errors of parameter estimation		Coefficient of determination	Student's T-test	Value p
dependent	independent	a_0	a_1	Sa_0	Sa_1			
$Y(kl)_3$	$X(kl)_1$	51.03	-0.223	1.708	0.050	0.62	-4.467	0.00077
$Y(kl)_4$	$X(kl)_1$	2767.2	8.788	76.81	2.246	0.56	3.912	0.00206

Source: Own preparation.



Table 5.
Variables describing the quality of human capital

Symbol	Specification	Measurement unit	Coefficient of variation (in %)
Y(jl) ₁	percentage of councillors with higher education in the city council	%	15.3
Y(jl) ₂	pre-school enrolment ratio	%	17.1
Y(jl) ₃	average score at junior high school final examinations (% of points scored)	%	4.2
Y(jl) ₄	number of primary school students per one computer	units	103.7
Y(jl) ₅	number of books borrowed from a library per one inhabitant	units	31.9
Y(jl) ₆	number of participants of municipal cultural events	persons	51.3
Y(jl) ₇	the dynamics of the median of inhabitants' age	%	57.7

Source: Own preparation.

Table 6.
Students learning foreign languages in the schools of Ustka

Year	Primary schools		Junior high schools	
	number of students	% of the total number of students*	number of students	% of the total number of students*
2008	1,243	126	609	133
2009	1,172	127	684	149
2010	1,131	127	679	176
2011	1,151	129	641	201
2012	1,109	125	524	200
2013	996	117	491	183
2014	1,206	131	498	210
2015	1,342	130	514	220
2016	987	105	494	217
2017	1,584	143	313	212

Notes:

* Students are recorded as many times as the number of languages they learn.

Source: Own preparation based on Local Data Bank (2021).

Table 7.
Variables determining the quality of human capital

Symbol	Specification	Measurement unit	Coefficient of variation (in %)
X(jl) ₁	commune's real spending on education per one inhabitant	PLN	13.9
X(jl) ₂	commune's real spending on health care per one inhabitant	PLN	18.3
X(jl) ₃	size of the book collection in the municipal library	items	4.2
X(jl) ₄	number of municipal cultural events	items	33.7

Source: Own preparation.



Table 8.
Matrix of correlations: human capital quality

Variables	Y(jl) ₁	Y(jl) ₂	Y(jl) ₄	Y(jl) ₅	Y(jl) ₆	Y(jl) ₇	X(jl) ₁	X(jl) ₂	X(jl) ₄
Y(jl) ₁	1.00								
Y(jl) ₂	-0.32	1.00							
Y(jl) ₄	0.87	-0.25	1.00						
Y(jl) ₅	0.86	-0.41	0.79	1.00					
Y(jl) ₆	-0.22	0.42	-0.26	-0.38	1.00				
Y(jl) ₇	-0.85	0.58	-0.81	-0.95	0.51	1.00			
X(jl) ₁	-0.54	0.49	-0.31	-0.76	0.15	0.71	1.00		
X(jl) ₂	-0.55	0.44	-0.60	-0.80	0.35	0.77	0.66	1.00	
X(jl) ₄	-0.43	0.79	-0.39	-0.63	0.71	0.76	0.57	0.56	1.00

Source: Own preparation.

Table 9.
The results of the regression analysis: the quality of human capital

Correlation between variables:		Assessments of model parameters		Standard errors of parameter estimation		Coefficient of determination	Student's T-test	Value p
dependent	independent	a_0	a_1	Sa_0	Sa_1			
Y(jl) ₆	X(jl) ₄	1954.4	40.26	1127.8	11.468	0.51	3.511	0.0043
Y(jl) ₇	X(jl) ₂	-0.0902	0.0062	0.0368	0.0015	0.60	4.215	0.0012

Source: Own preparation.

Table 10.
Variables describing the level of local economic development

Symbol	Specification	Measurement unit	Coefficient of variation (in %)
Y(lrg) ₁	wealth index (natural person)	PLN	13.8
Y(lrg) ₂	wealth index (legal person)	PLN	38.5
Y(lrg) ₃	poverty rate	%	40.5
Y(lrg) ₄	unemployment rate	%	30.5

Source: Own preparation.

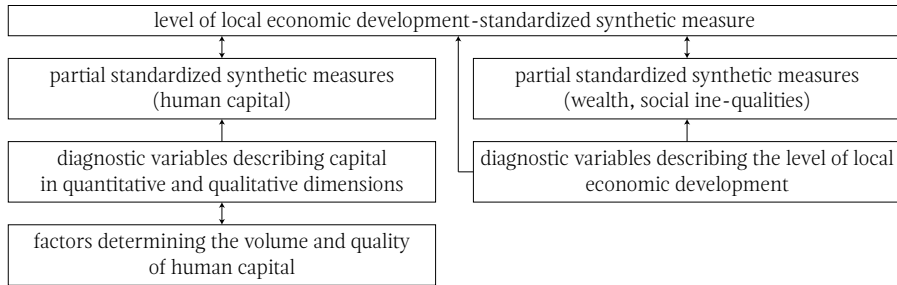
Table 11.
The results of the regression analysis: the quality of human capital and the level of local economic development (LRG)

Correlation between variables:		Assessments of model parameters		Standard errors of parameter estimation		Coefficient of determination	Student's T-test	Value p	Importance factor
dependent	independent	a_0	a_1	Sa_0	Sa_1				
level of LRG	quality of human capital	0.0587	0.947	0.0725	0.1534	0.76	6.173	0.00005	0.872

Source: Own preparation.



Scheme 1.
Structure of the LRG model

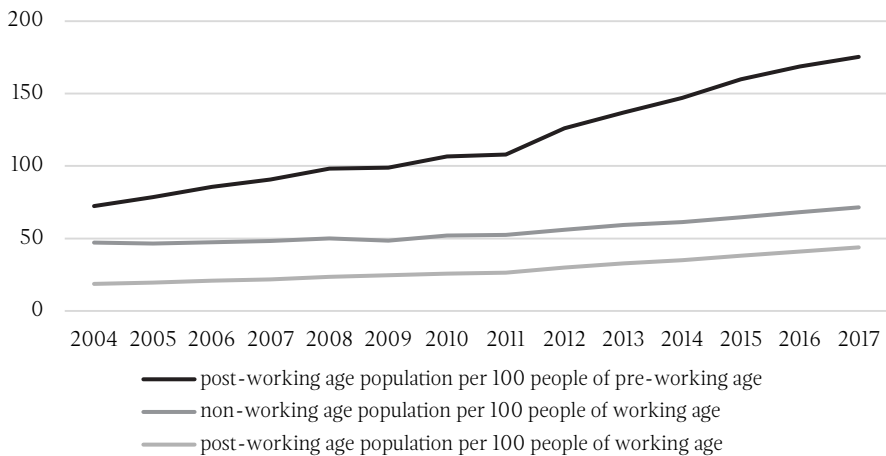


Notes:

↔ regression analysis; → aggregation.

Source: Own preparation.

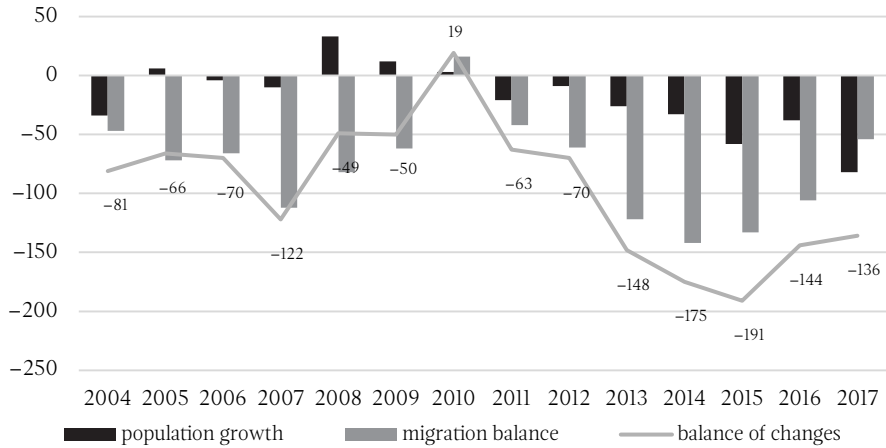
Chart 1.
The demographic structure of the population of Ustka



Source: Own preparation based on Local Data Bank (2021).

Chart 2.

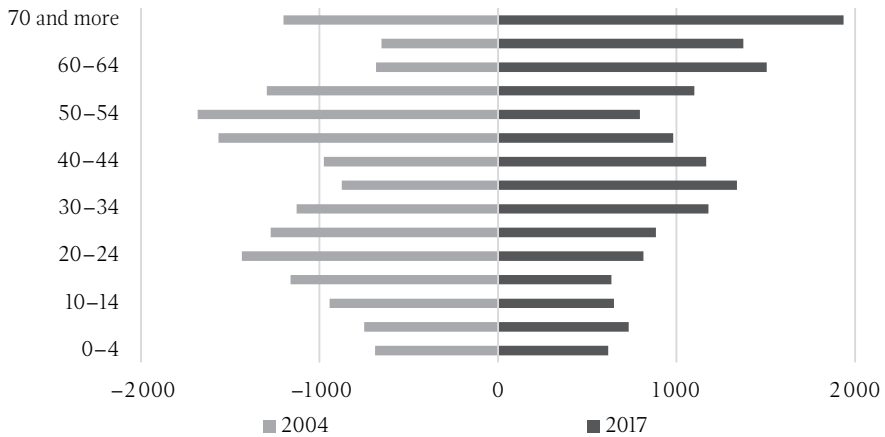
Changes in the size of the population of Ustka in total (persons)



Source: Own preparation based on Local Data Bank (2021).

Chart 3.

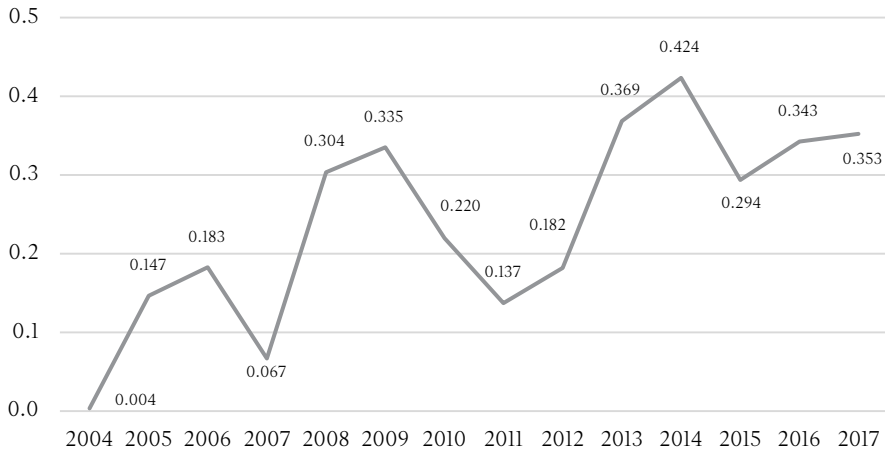
The pyramid of age of the population of Ustka, years 2004 and 2017 (persons)



Source: Own preparation based on Local Data Bank (2021).

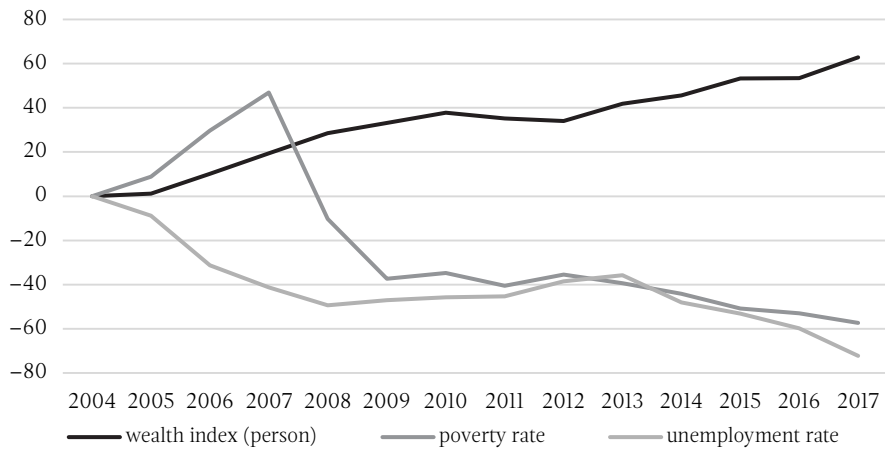


Chart 4.
The synthetic measure of human capital (HC)



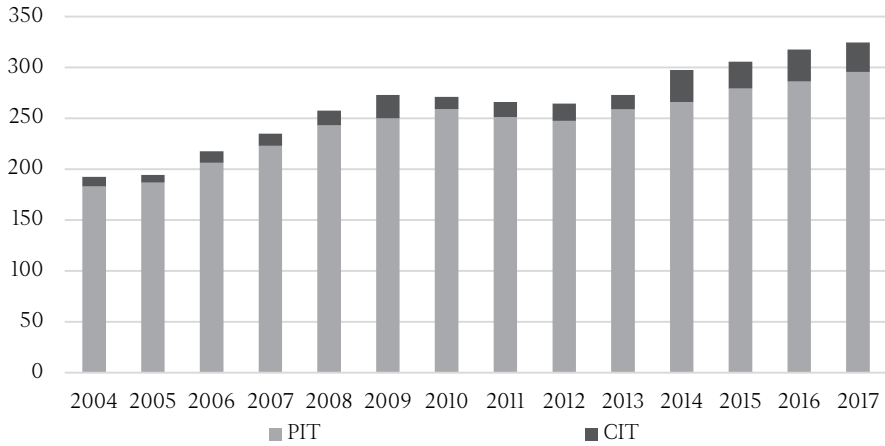
Source: Own preparation.

Chart 5.
Dynamics of wealth of natural person, poverty rates and unemployment rates (cumulatively)



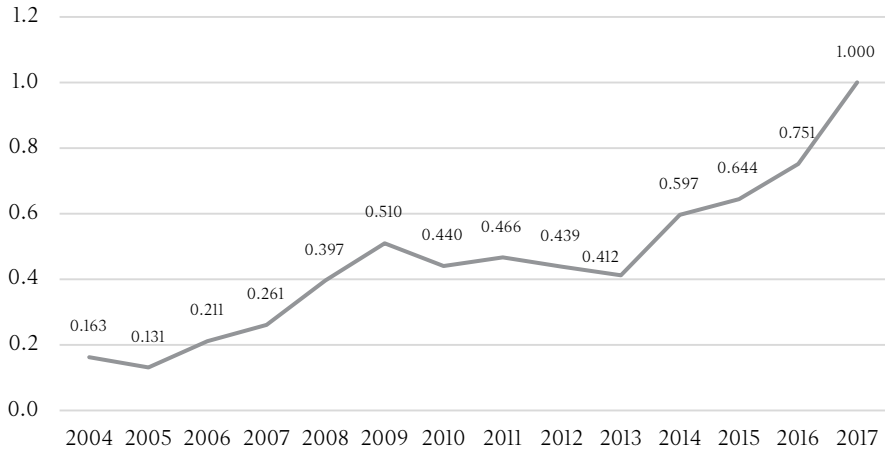
Source: Own preparation.

Chart 6.
Real income of PIT and CIT (million PLN)



Source: Own preparation.

Chart 7.
Synthetic measure of local economic development (LRG index)



Source: Own preparation.

