THE ROLE OF HEALTH INEQUALITIES IN HUNGARY'S URBAN ECONOMIC DEVELOPMENT

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Abstract

Our study is about the economic inequalities of the Hungarian urban network, according to the health condition. Barro (1996, 2013) and Tompa highlight that the theories (new growth theories, Romer 1986, Lucas 1988) explaining the economic growth, the aspects of the knowledge and technology got basicly in the foreground in connection with the human capital. This trend can be felt in the territorial researches interpreting the development and competitiveness of Hungary, for example due to the territorial capital-, or competitiveness researches (Nemes Nagy-Németh 2003, Lukovics-Kovács 2008, Lengyel-Szakálné Kanó 2012, Jóna 2013). Even if the health appears in some kinds of shape, that refers rather to the availability of the infrastucture, in addition, the correct presence of the health conditions are really rare in the different modells.

That is why, the aim of our research is the health condition (with special regard to the premature mortality) as the discovery and review of human resource relating to the urban economy development. In this study the explanatory spatial data analysis (ESDA) is used for it. This method gives us the opportunity to show the spatial regularities and relations (uni- and bivariate territorial autocorrelation, regression models reflecting spatial characteristic). With the help of the spatial econometric methods we had been searching for the answer what influence have the the health condition and other control variables on the evolution of the city economy performance (income/capita, unemployment rate).

JEL code: I14, I15, R10

Introduction

Many theories and models have been devised for the purpose of explaining the socio-economic inequalities of health status (Preston 1975, DHHS 1980, Mackenbach 2012). According to literature discussing the inequalities of health status and socio-economic development, there is a synergistic interrelationship between these two phenomena coupled with a double cause-and-effect mechanism (WHO 2002). The socio-economic environment determines the health status of both individuals and society as a whole while, in exchange, health influences the socio-economic status of individuals as well as the socio-economic processes at macro level (Acheson 1998, EC 2005, Grossman 2000, Barro 2013, WHO 2001, OECD-WHO 2003, Sen 1998). This paper focuses on the latter concept, defining health status, based on Grossman (1972), as a production factor and examining its impacts on economic inequalities. The health condition of an individual affects not only his own social status but influences, through various channels, the economy and economic growth as well. The better health status of an individual has a direct impact on the supply side of labour market: if in good health, an individual participates in the labour market, does not apply for (possible) early retirement and does not absorb the capacities of a family member to take care of him and his illness. An individual in good health has higher productivity and, thus, higher wages and income. Health status also generates indirect educational implications: schoolchildren who tend to become ill more often or suffer from nutritional deficiencies will have higher absence rates and higher chances for dropout from school. In addition, health status has an impact on income distribution: healthy individuals show a higher tendency to accumulate savings, make investments and indulge in consumption.

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Improved health status also means intergenerational spill-over effects (OECD-WHO 2003), i.e. it leads to decreased fertility rates in the long run.

The testing of conditional convergence, an empirical approach applied to this subject by Bloom and Canning (2005), means an estimation of (macro) income growth per capita, involving the initial health status (life expectancy at birth, mortality rates) and keeping income levels and other factors under control. Such other factors may include e.g. political variables (institutional features, state of democracy, rate of inflation, government spending, exchange ratio, law and order, etc.), education ratios, population growth, technological progress, fertility, geographical features, natural resources, etc. (Barro 1996, Barghava et al. 2001, Bloom et al. 2004, Bloom-Canning 2005, Weil 2005, Barro 2013). Macro-level examinations confirm the general beneficial impacts of health status on economic growth for a time span of one or even more centuries (Fogel 1994, Arora 2001). Regional studies – just like the main macro-level analyses – describe the regional aspects of catch-up, level of development and competitiveness in the context of health status (Vanicsek et al. 2003, Malmberg-Andersson 2006, Noronha et al. 2010, Ana Pocas 2012, Annoni-Dijkstra 2013, Blázquez-Fernández et al. 2014). In general, the few regional studies confirm the results of macro-level analyses but, at the same time, numerous specificities and differences in findings are also evident. First, the health status variables cover a wider spectrum: age-specific mortality (e.g. perinatal, infant, premature mortality) is coupled with cause-specific mortality (cardiovascular diseases, cancer, infectious diseases, etc.) and lifestyle-related mortality (alcohol and smoking). Furthermore, hospital health status indicators (number of patients, number of cases, number of hospital days) and other proxy variables (number of persons receiving sickness benefits, rate of early retirement, number of medical prescriptions) are used for this paper. Second, the regional analyses involve a wider range of dependent variables – health status indicators have beneficial impacts (although at different levels) not only on economic growth but also on certain latent variables created through main component analysis and having some economic value (Vanicsek et al. 2003, Malmberg-Andersson 2006), as well as on wages, investments and GDP per capita. Nevertheless, opposite results also emerge in certain cases. For example, according to the findings of a conditional convergence test conducted by Noronha et al. (2010) for Brasil, cancer and diabetes mortality rates have a beneficial impact on growth prospects.

Study questions

It is clear from a series of complex mathematical-statistical studies that the abovementioned topic remains relatively neglected in the examination of health inequalities at subnational level. That is why our paper is aimed at mapping the direct impacts of health status in Hungary at subnational level. We have selected a special area level: urban areas. In fact, urban areas are considered as the priority constituents of regional economic growth, the privileged actors of regional development and the main determinants of national productivity, employment, education and innovation (ESDP 1999, EC-UN Habitat 2016).

Our first study question is as follows: what is the impact of aggregate health status on the urban inequalities of economic development in Hungary? According to our hypothesis, proper health status represents a major human resource input for the main urban-level output indicators of economic performance. In view of that, and on the basis of international literature findings, our aim is to create and test a model that focuses on the main indicators of Hungary's urban-level economic development and reveals the direct impacts of health status. Given that the subnational analyses available in international literature have ignored spatial interactions so far, we wish to make up for this deficiency in our paper by assuming that spatiality plays an active role in the abovementioned interrelations. Accordingly, our second study question is as follows: what is the contribution of spatiality to the relationship between health status and economic development?

Materials and methods

Our cross-sectional base model is as follows:

$$CED_{i,t} = CED_{i,t-x} + H_{i,t-x} + HC_{i,t-x} + AS_{i,t;i,t-x}$$

where CED (*city economic development*) on the left means urban-level economic development, while CED on the right represents the former state of development, H means health status and HC (*human capital*) indicates additional human resource dimensions (which are relevant also in terms of health). AS (*active spatiality*) means such factors as accessibility, neighbourhood effects, economies of scale, etc., *i* refers to the unit of observation, while *t* and *t–x* indicate the time of observation.

Table 1 – Main features of the study database

indicator	minimum	maximum	average	std. deviation	Moran I
income per capita, HUF/person (log) (2014)	13.03	14.28	13.63	0.22	0.40
unemployment rate, % (log) (2014)	0.03	3.16	1.89	0.55	0.56
standardized mortality ratio (2005-2010)	246.00	806.60	470.2	98.52	0.20
proportion of higher education graduates, % (2011)	5.10	39.9	14.42	6.53	0.18
young age dependency ratio, % (2011)	17.13	41.42	24.53	3.87	0.25
proportion of roma population, % (2011)	0.00	25.11	3.54	4.08	0.28
convergence club (dummy) (2011)	0.00	1.00	0.36	0.48	0.75
peripherals (dummy) (2011)	0.00	1.00	0.17	0.38	0.19
proportion of industrial workers, % (1970)	1.91	83.08	35.96	16.97	0.32
population change, % (1970-2011)	65.68	385.6	110.7	38.94	0.20
unemployment rate, % (1990)	0.41	6.23	1.92	0.81	0.33

For Moran's I, the spatial weights matrix is based on a 60-km distance matrix with 999 permutations and a significance level of $p<0.05$. As $-1/N-1 = -0.0029$, no spatial autocorrelation can be seen here; however neighbourhood assimilation is positive above and negative below this value.

Our paper approaches the economic development of urban areas on the basis of competitiveness; this term overlaps with growth and development, and it is also synonymous with the latter. Competitiveness at subnational level is a complex and "more quality-focused" indicator: it indicates a type of sustainable development which is realised at a high level of employment (i.e. it incorporates a main indicator of social development), coupled with high and growing standards of living, valid for a longer time span and associated also with regional development (EC 2004, Lengyel 2012). By highlighting two categories of this term, we use income per capita and unemployment rate for the purpose of dependent variable.

Urban health status is expressed through the premature (0–64 years) version of the standardised death rate (SDR[1]). The selected age group is important as it has a direct effect on the state of economy (Vanicsek et al. 2003). The mortality rate applicable to the cohort can be considered relevant also because the region is affected by the Central and Eastern European health paradox (Kopp-Réthelyi 2004), a mortality crisis affecting the region's middle-aged population. Similarly to some studies concerning the direct impact of health status (Barro 1996, Noronha et al. 2010, Silva Alves Pocas 2012, Blázquez-Fernández et al. 2014), we use education and fertility indicators as primary control variables. The knowledge dimension is indicated by the proportion of higher education graduates, while fertility is expressed, indirectly, through young age dependency ratio which refers to the age structure. Furthermore, the proportion of Roma

[1] Eurostat (2012) crude mortality rate calculated as a weighted average of age-specific death rates for the European standard population.

population is involved in the explanation of unemployment and income position. Acting via various channels such as low education levels, disadvantaged areas or labour market discrimination, this indicator is considered important in Hungary (Németh 2008, Pásztor-Pénzes 2012). Due to the endogenous nature of our study, area is considered as an active player. This arrangement is facilitated through the incorporation of dummy variables (convergence clubs indicating the spatial structure features of Hungary's economy) and with the involvement of internal and external peripherals. A value of 1 is assigned to the regions in Central Hungary, Central and Western Transdanubia[1], while the remaining regions are indicated with 0. The boundaries of the internal and external peripherals are based on the districts to be developed through complex programme[2] as defined in Government Decree 290/2014 (XI. 26.). The towns of these districts are indicated with 1 and the remaining towns are marked with 0. We are aware of the fact that "area development cannot be explained with a single or just a few factors because it requires an effort to examine a whole series of elements and their combined interactions" (Rechnitzer 1998, p. 19), and that is why we employ the time-delayed version of the development variable or the relevant proxy variable. The former state of development is used to express the endogeneity of the complex phenomenon (long-term effects, determinations) and to eliminate the eventual distorting effects of other regressors from the equations (Acemoglu et al. 2001, Németh 2008). For the purpose of handling the endogeneity of income level in our models, we use the proportion of industrial workers – it is a development indicator, based on the studies of Győri (2007) and Németh (2008), characteristic of the socio-economic conditions of the 1970s. In addition, we use the indicator of population change (1970–2011). Also, we use the indicator of unemployment rate (1990) in order to describe the former state of development. It is assumed that these indicators are able to eliminate the endogeneity of the current state of development.

The remaining explanatory variables are used in their time-delayed form. The reason behind this decision is to avoid the simultaneity between response and explanatory variables (in the specific case of health status and economic development), and that is why we apply this solution proposed by Noronha et al. (2010).

The subnational level of our study affects all Hungarian towns with a population of more than 2 000 persons. We have decided to omit six towns in order to reduce the statistical uncertainty of the data. Our data source is the National Regional Development and Spatial Planning Information System and the tabulated (mortality) database compiled by the Central Statistical Office upon individual request.

In addition to various spatial parameters, the applied method i.e. ESDA (explanatory spatial data analysis) is also linked to the expression of spatial interactions. We use maximum likelihood regression models (Anselin 2005), which offer spatial lags and spatial errors, to display the relationship among the current and former state of economic development, health status, education and other variables. Wald (W), Likelihood Ratio (LR) and Lagrange Multiplier (LM) tests are used to verify asymptoticity and spatial dependence. According to Anselin (2005), their sequence should be W > LR > LM. Any failure to reach this sequence may lead to specification errors: the residuals fail to show normal distribution, the variables feature non-linear relations, the range of regressors is insufficient and improper or the spatial weights

[1] We have selected this method in view of the divided nature of Hungary's (income and unemployment) spatial structure. The north-western and central regions, which can be considered the winners of the process of Hungary's transition to a market economy, now account for almost 70% of Hungarian GDP, while the remaining regions are hit by exclusion or stagnation (Lőcsei 2010, Pénzes 2013).

[2] It is the category of the most backward districts.

matrix is inadequate. The Breusch-Pagan test is used to test for heteroskedasticity, while multicollinearity is measured with MCN. Model effectiveness is verified with pseudo R-squared, Akaike's Information Criterion (AIC), Log likelihood and Schwarz's Bayesian Information Criterion (Anselin 2005).

Results

For each development indicator we have conducted two cross-sectional regression analyses – one model is based on ordinary least squares (OLS) and another (spatial maximum likelihood) model is based on the Lagrange multiplier. Here we describe only the final or best matching models meeting the diagnostic requirements.

Table 2 – Regression models for the economic performance of towns (income per capita)

	OLS	ML SEM
constant	13.562* (225.809)	13.704* (183.978)
mortality	-7.798e-005 (-0.891)	-0.0002** (-2.005)
qualification	0.016* (12.511)	0.015* (11.845)
convergence_club	0.143* (9.125)	0.079* (3.401)
industrial traditions	0.002* (4.145)	0.001* (2.928)
young age dependency	-0.009* (-3.911)	-0.011* (-5.593)
roma pop.	-0.008* (-4.378)	-0.008* (-4.041)
lambda	-	0.835* (10.511)
R-squared	0.731	0.754
Log likelihood	257.165	265.987
Akaike info criterion	-500.329	-517.974
Breusch-Pagan test	10.555	12.066
Wald-test	-	110.481
Likelihood Ratio Test	-	17.645*
Lagrange Multiplier (error)	13.266*	-
Lagrange Multiplier (lag)	10.009*	-

Note: * significant at 0.01, ** significant at 0.05, *** significant at 0.10. The spatial weight matrix is based on 80 km distance based contiguity. See the t- (OLS model) and z-score (ML model) values in parentheses. N=340. Source: own calculation, editing (2017)

It is advisable to use the spatial error model, based on Lagrange multiplier, for income per capita (Table 2). Almost all explanatory variables make a significant contribution to the different values of economic performance in Hungarian towns. The only exception is found in the OLS model, where the standardised mortality rate cannot be considered reliable. However, it becomes reliable in the spatial model. In general, regressors behave according to preliminary expectations. Towns with higher income per capita have a population with a higher level of education, older age structure and better health status, and less Roma people. Towns in the north-western and central regions outperform those found in other regions of Hungary. The proportion of industrial workers (1970) (industrial traditions) – a time-lagged proxy expressing the endogeneity of income performance – is shown with positive sign in the regression equation, which confirms former Hungarian literature findings. (Győri 2007, Németh 2008) In other words, the long-term impact (dating back to more than four decades) of the former development spatial structure can still be felt and plays a determinant role. The lambda parameter (neighbourhood relations) proves to be a significant and strong player in the ML equation, and this fact means spatial interactions. Having passed the diagnostic tests, the spatial model explains the inequalities of urban economic development with a fairly high efficiency (pseudo R-squared: 75.4%, Log likelihood and AIC values are better than in the OLS model). In view of z-score values indicating the stability of individual variables, one of the weakest (but significant) predictors is early mortality, while qualification is the strongest player in spatial regression.

Table 3 – Regression models of urban unemployment in Hungary

	OLS	ML SEM
constant	1.416* (8.824)	1.555* (5.760)
mortality	0.0007* (2.869)	0.0005** (2.277)
qualification	-0.014* (-3.709)	-0.016* (-4.589)
convergence_club	-0.505* (-12.605)	-0.345* (-6.063)
unemp90	0.155* (6.085)	0.112* (4.492)
young age dependency	0.014** (2.532)	0.010*** (1.866)
pop_change	-0.001** (-2.279)	-0.002* (-3.135)
complex_backwardness	0.150* (2.936)	0.137* (2.838)
lambda	-	0.923* (19.070)
R-squared	0.672	0.701
Log likelihood	-86.055	-74.199
Akaike info criterion	188.11	164.398
Breusch-Pagan test	17.719**	15.980**
Wald-test	-	363.665
Likelihood Ratio Test	-	23.712*
Lagrange Multiplier (error)	22.170*	-
Lagrange Multiplier (lag)	20.298*	-

Note: * significant at 0.01, ** significant at 0.05, *** significant at 0.10. The spatial weight matrix is based on 100 km distance based contiguity. See the t- (OLS model) and z-score (ML model) values in parentheses. N=340. Source: own calculation, editing (2017)

Parallel with economic performance, the spatial error model describes, in a more or less correct way, the relationship between health status and unemployment (Table 3). In addition to health status, the independent variables include young age dependency, qualification, convergence club dummy, population change, the Bernoulli variable of peripherals and the former (autoregressive) value of independent variable. Towns with an above-the-average unemployment rate show higher early mortality rates and youth percentage and below-the-average rates of university diploma holders. Spatiality in ML regression is expressed not only by the space-lagged residuals (lambda parameter) of the

OLS model but also by convergence club and peripheral dummy variables. The regions in Central Hungary, Central and Western Transdanubia have been traditionally performing better, while the complex crisis phenomena of the internal and external peripherals are also present in the unemployment rate, clearly increasing its level. The time-lagged (1990) version of the independent variable can be considered as a significant regressor (not causing multicollinearity) in the differentiation of urban unemployment after almost a quarter of a century. Population change, expressing the endogeneity of economic development, is also associated with changes of the unemployment rate: towns with higher unemployment rates show significantly higher population growth rates. The health state indicator still cannot be considered as a major regressor (it is slightly higher than the z-score value expressing the age structure); the lambda parameter proves to be the most stable explanatory variable in this model. With a Nagelgerke R-squared of 0.710 and an AIC of 160.40, the spatial model shows a better matching. However, spatial regression cannot be considered fully perfect in terms of diagnostics: the Breusch-Pagan test shows heteroskedasticity, although its asymptotic tests correspond to the sequence published by Anselin (2005).

It should be noted that it would be justified to use different spatial weights matrixes for the two economic development indicators (80 km distance based for income and 100 km distance based for unemployment) in order to adequately comply with the diagnostic tests. It indicates different ranges for the spatial differentiation of the two phenomena; the urban-level spatial inequalities show different neighbourhood patterns in terms of the studied phenomena.

Summary

Our paper carries out a special examination of health inequalities at subnational level and studies the direct impact of aggregate health status, as a production factor, with regard to Hungary's economic performance. Our paper focuses on towns i.e. the priority actors of economic development in the region.

Our study is based on international findings. We have created a mathematical-statistical model which takes into consideration the diverse approaches to economic development, the endogeneity of development indicators, the special (adapted) dimension of health as well as the spatial interactions not managed so far. According to our assumption, health status is an adequate determinant of urban income position and unemployment. In our opinion, this assumption has been confirmed: the applied spatial regression models effectively indicate the positive impact of health on development indicators and supplement the traditional explanatory factors such as knowledge, age structure and spatiality. Our studies affect the endogeneity of urban development as well. We have demonstrated that economic performance, unemployment and income show a significant relationship of various strength (without multicollinearity) with their own (or with their proxies') former spatial inequality. Furthermore, spatiality is a reliable player of major importance in the explanation of the inequalities of urban-level economic development. It should be noted that the spatial patterns affecting urban income and unemployment are different and that the studied phenomena are described by neighbourhood relations of different distances.

Under the current study conditions, health status cannot be considered as a major actor in the explanation of economic development; in fact, knowledge, spatiality, contiguity or the "past" are seen as stronger explanatory factors. However, according to Sen (1999), "good health is considered as an integral part of good development". It is particularly important for a CEE country which is characterised by significant excess mortality (WHO 2013, Vagero 2010).

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