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DOES THE OPINION OF RESIDENTS MATTER? AN ANALYSIS OF MIGRATION IN EUROPEAN CITIES

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Abstract

This paper aims to determine push and pull factors of migration in 70 European cities. Using panel regression analysis, we explain migration balances by set of variables which represents city residents' assessment on state of local labour market, air quality, different aspects of life in the cities (public services) and pollutant PM 2.5. The results show that quality of air (both subjectively and objectively measured) as well as perceived availability of job opportunities are significant push and pull factors for migration. The variables representing residents' assessments of public services are mostly insignificant, with the exception of their satisfaction with health care services and facilities, public transport, and safety, which can be considered as pull factors for migration. In conclusion, we offer some recommendations to economic policymakers.

Keywords

Migration, European Cities, Panel Regression Analysis, Push and Pull Factors

I. Introduction

The research of determinants of human migration has a long history. The origins of the research date back to the 1880s, when G.E. Ravenstein (1885) defined the laws of migration. In the 20th century, many migration theories emerged. They aimed to identify the reasons why people migrate. Attention was primarily paid to the economic factors of migration. In most cases, the economic theories viewed migration as a consequence of different states of economies and labour markets between individual countries. An enumeration of these theories, which were mainly oriented towards clarifying the causes of international migration, is offered by, for example, Massey et al. (1993).

The validity of economic theories has been confirmed many times, but there are other possible reasons why people migrate. Push and pull theory expanded the view of migration factors, which were divided into two groups, those that pull migrants to the destination and those that push migrants out of their place of origin. Among the push and pull factors we can specifically include, for example, political stability, the quality of public institutions, law enforcement and security, environmental factors, or the quality of public services (Bansak et al., 2021).

As noted above, most of the original migration theories were primarily oriented towards explaining international migration. However, some of these theories can be also applied to research on migration at the national level of regions, counties, or districts (e.g. neoclassical theory or network theory). Research on migration at the city level is also highly relevant, as it influences not only local labour markets but many other aspects of city life. The results of this kind of research can be, for example, an important input for the creation of strategic plans of cities/municipalities.

The aim of this paper is to determine the factors of migration at the level of European cities.

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Migration balance per 1 ths. inhabitants, for the calculation of which data from Eurostat and national statistical offices were used (Eurostat, 2021a), will be explained using panel regression with random effects. Explanatory variables represent the subjective average assessment of satisfaction of respondents (residents) of European cities with various areas of life (public services). Furthermore, the migration balance will be explained by respondents' satisfaction with air quality and with the state of the labour market. The source of this data is the Eurobarometer surveys of the European Commission from 2004 to 2019 (EC, 2020; 2016, 2013, 2010, 2007; Eurostat, 2021b). In selected models, satisfaction with the air quality will be replaced by objectively measured pollution, namely the pollutant PM 2.5, while the source of this data is the European Environment Agency (EEA, 2021).

Using data from the Eurobarometer survey makes it possible to include public service variables in the research. According to the best author's knowledge, the database of city amenities such as the number of theatres or the area of green space in hectares, is absent. Furthermore, the inclusion of variables expressing respondents' opinions on the state of the labour market (perceived availability of job opportunities) can be an interesting alternative to commonly used objective indicators, such as the number of job vacancies or the level of unemployment, while these data are often not available at the city level. The motivation for choosing these data is also the very use of the subjective assessment of the state of the cities by their residents and finding out whether this subjective assessment can explain migration in the same way as the traditionally used objective variables.

The first section provides a literature review. The second chapter describes the data and the regression model. In the third chapter, the results will be presented and discussed. The last chapter is a conclusion with suggestions and recommendations for economic policymakers.

II. Literature Review

There is a large body of studies on human migration in the empirical literature. Most studies aim to identify the factors that cause migration. A significant part of the literature is devoted to the economic factors of migration. The hypotheses and objectives of these studies are based on the findings of traditional economic theories (Massey et al., 1993) and test their validity at different levels. These include not only international migration (Mayda, 2010; Jennissen, 2003), but also migration at the level of regions/counties (Pakši et al., 2023; Basile et al., 2019). Among the traditionally investigated economic factors of migration are differences in the labour market conditions of the place of origin and the place of destination, such as the level of unemployment or the level of wages.

Jennissen (2003) dealt with the economic factors of international migration in Western European countries. The author used data for the period 1960-1998. The result of his research is that economic growth expressed in GDP per capita is positively associated with net migration and an increase in unemployment is negatively associated with net migration. Mayda (2010) dealt with the determinants of migration in OECD countries in the years 1980-1995. The author found out that the level of GDP per capita is positively related to international migration. Specifically, a 10% increase in GDP per capita in the destination country will lead to a 20% increase in emigration from the country of origin.

Basile et al. (2019) looked at interregional migration in Italy, using data from 2002-2011 at the NUTS 3 level. The authors' attention was paid to migration from the south of Italy, which faces higher unemployment, to its northern regions. They found different impacts of migration on regional labour markets according to the level of migrants' human capital. The migration of highly educated people deepens the differences in unemployment levels between regions (there is an increase in unemployment in the place of origin and a decrease in unemployment in the destination), on the other hand, the migration of less educated people reduces the differences in unemployment levels (there is a decrease in unemployment in the place of origin and an increase in unemployment in the destination). As the effect of the migration of more educated people is higher, differences between Italian regions may be deepening.

The importance of the state of the labour market is also confirmed by Pakši et al. (2023). The authors dealt with the factors of migration at the level of regions in the Czech Republic, in the period 1995-

2018. They found out that the number of job applicants and employees in industry are push factors of migration. On the other hand, higher GDP growth, higher number of job vacancies and higher number of finished dwellings attract migrants to the given region and thus can be considered as pull factors of migration. A number of college students and criminality rate do not explain a migration in Czechia regions.

A significant body of empirical studies deal with environmental migration. The authors pay attention to whether migration is caused by impact of climate change such as natural disasters (Gray and Mueller, 2012) or whether migration can be caused by a polluted environment, such as air pollution. Also, the effect of air pollution on migration is investigated at the international level (Xu and Sylwester, 2016), on the level of provinces/regions (Kim and Xie, 2019) or cities (Balcar and Šulák, 2020).

Xu and Sylwester (2016) investigated the relationship between migration from low- and middle-income countries to OECD countries and the level of air pollution, which was approximated by the level of pollutant PM 2.5. They found out that air pollution is a push factor of migration, but not the most important one, and that migration due to air pollution is connected mainly with highly educated people.

Kim and Xie (2019) looked at the relationship between air pollution and migration among Chinese provinces, using daily AQI (air quality index) values as a proxy variable for air pollution levels. They found that a one-unit AQI increase leads to a 1.1% increase in the rate of migration to a less polluted province, and that people migrate mainly to provinces where the AQI value is 20 to 35 points lower than the province of origin. They also found out that each additional polluted day (AQI > 150) leads to a 0.6% increase in migration to provinces with better air quality if the difference in "unhealthy days" between provinces is at least 20 days. According to the authors, these results testify to the current migration trend leading to population decline in Chinese megacities.

Balcar and Šulák (2020) focused on the relationship between polluted air and the migration intentions of the inhabitants of the city of Ostrava. In their research, they used data from a questionnaire survey, which contained data on respondents' migration plans and their subjective satisfaction with air quality. These data were supplemented with objective data on air pollution expressed by the level of pollutants PM 2.5, PM 10, NO_2, and benzo(a)pyrene. They found out that satisfaction with the natural environment is a significant "push" factor for migration from Ostrava, regardless of whether the potential migrant plans to move out from Ostrava within commuting distance or outside the commuting distance. It is also shown that all pollutants included in the research play a role in considerations of migration from Ostrava outside the commuting distance, with the pollutant PM 2.5 also playing a role in considerations of emigration within the commuting distance. More educated people and people with small children under the age of five mostly consider migrating.

Some studies are focused on the relationship between migration and the availability of public services/amenities, that represent different areas of life in the place where people live or are considering moving. This is, for example, the availability of greenery and parks or sports, cultural or healthcare facilities. The availability and quality of these areas of life can influence residents' decisions about whether to migrate and, if so, where. For example, Arif et al. (2022) found out that the construction of sports stadiums in the US is not associated with migration between metropolitan statistical areas. On the other hand, Sørensen (2008) found out that closures of rural hospitals in Denmark may lead to outmigration, as 29 % of questioned respondents (N=1000) would consider moving away from their current place of residence if their hospital was closed. Mikula and Pytliková (2020) found out that the effect of air pollution (SO_2 pollutant) on emigration was stronger in municipalities less equipped with educational, health care, cultural, sports and public administration facilities.

The number of studies that deal with whether the availability and quality of public services/amenities such as sports, cultural or health care facilities or greenery and parks can be considered as

determinants of migration is very limited compared to research of economic and environmental determinants of migration. This paper will contribute to filling the identified research gap.

III. Data and Methodology

Based on the result of the Hausmann and Breusch-Pagan Lagrange multiplier test, a panel regression analysis with random effects was performed (Torres-Reyna, 2007). The regression model can be written as follows:

$$mb_{it} = \hat{\beta}_0 + \hat{\beta}_1 \cdot pt_{it} + \hat{\beta}_2 \cdot hc_{it} + \hat{\beta}_3 \cdot cf_{it} + \hat{\beta}_4 \cdot c_{it} + \hat{\beta}_5 \cdot gs_{it} + \hat{\beta}_6 \cdot sf_{it} + \hat{\beta}_7 \cdot s_{it} + \hat{\beta}_8 \cdot lm_{it} + \hat{\beta}_9 \cdot enviro_{it} + \hat{\beta}_{10\ldots k} \cdot country + \mu_{it} + \varepsilon_{it} \quad (1)$$

Explanation of model variables are provided in table 1.

Table 1 Explanation of variables of regression model

Variable	Explanation	Source
Explained variable		
migration balance per 1 ths. inhabitans (mb)	(yearly change of city population as of the 1 of January - natural change)/stock of population as of the 1 of January*1000	Eurostat and national statistical offices
Explanatory variables		
public transport (pt), health care services and facilities (hc), cultural facilities (cf), cleanliness (c), green spaces (gs), sport facilities (sf)	% of respondents who claimed they are satisfied (models 1.1 and 1.2) or unsatisfied (models 2.1 and 2.2) with these areas of life	Eurobarometer 2019, 2015, 2012, 2009, 2006, 2004
safety (s)	% of respondents who claimed they feel safety in the cities (models 1.1 and 1.2) or do not feel safe in the cities (models 2.1 and 2.2)	Eurobarometer 2019, 2015, 2012, 2009, 2006, 2004
labour market (lm)	% of respondents who claimed they think it is easy to find a good job in the city	Eurobarometer 2019, 2015, 2012, 2009, 2006, 2004
air quality (enviro) (models 1.1 and 2.1)	% of respondents who claimed they are satisfied (models 1.1 and 1.2) or unsatisfied (models 2.1 and 2.2) with quality of air in the cities	Eurobarometer 2019, 2015, 2012, 2009, 2006, 2004
particulate matter 2.5 (enviro) (models 1.2 and 2.2)	level of pollutant PM 2.5	European Environmental Agency
country	control variables (dummies)	-

Source: Author

A positive regression coefficient is expected for all explained variables, as it can be expected that higher satisfaction with the given areas of life, a higher feeling of security, and greater availability of job opportunities will have a positive effect on the migration balance, which means higher immigration or lower emigration.

The model was estimated in the second variant (model 1.2 in tab. 2), namely with the objectively measured pollutant PM 2.5 instead of subjective satisfaction with air quality. This pollutant was included in the research because particulate matter up to 2.5 micrometers in diameter (PM 2.5) is one of the most significant pollutants causing health problems and premature deaths (Sun et al., 2021). According to estimates, the pollutant PM 2.5 caused 379,000 premature deaths in the European Union states in 2018 (Sicard et al., 2021; EEA, 2019). In the case of the explained variable PM 2.5, a negative

regression coefficient is expected, as it can be expected that a higher level of pollution will be negatively associated with the migration balance (lower immigration or higher emigration).

The explanatory variables of the third and fourth variants of the model (models 2.1 and 2.2 in tab. 2) express the overall unsatisfaction of the respondents with individual areas of life in the given cities (in the case of the safety and labour market variables, disagreement with the statement that the respondent feels safe in the given city, or that it is easy to find a job in that city). Negative regression coefficients are expected in these models, as higher dissatisfaction with these areas of life should reduce immigration or increase emigration. The difference between models 2.1 and 2.2 lies in the environmental variable, where in model 2.1 the environmental variable is represented by overall dissatisfaction with air quality and in model 2.2 by the level of the pollutant PM 2.5.

The above approach allows:

- to fulfil the stated aim of the paper, which is to determine the factors of migration at the level of European cities;
- find out whether the migration balances of the given cities can be explained through the opinions (assessment) of city residents on the state of various areas of life;
- include in migration research other variables that are not given significant attention in the empirical literature, and contribute to filling the identified research gap (public services);
- compare the results of models whose variables express the overall satisfaction of respondents with models whose variables express overall unsatisfaction of respondents, and thus identify potential push and pull factors for migration;
- compare results for subjectively felt and objectively measured air pollution;
- contribute to research on the determinants of migration at the level of European cities.

IV. Results and Discussion

Tab. 2 shows the results of four regression models, the construction of which was explained in the previous chapter.

The results show that there is a statistically significant relationship between migration and the quality of the air. The regression coefficients of the environmental variables correspond to the established assumption in all models. Higher satisfaction with air quality is associated with higher immigration or lower emigration ($p < 0.05$), while higher dissatisfaction with air quality or higher levels of PM 2.5 pollutant pollution has the opposite effect on migration, reducing immigration and increasing emigration ($p < 0.05$). Air quality thus acts as both a pull and a push factor. These results are in line with result of studies on environmental migration (i.e. Balcar and Šulák, 2020; Xu and Sylwester, 2016).

The results of the variables that represent individual areas of life in the cities are, with some exceptions, statistically insignificant. In model 1.1, there is a statistically significant regression coefficient of satisfaction with health care services and facilities ($p < 0.01$) and with a feeling of safety ($p < 0.1$), both with a positive regression coefficient as was expected. Higher satisfaction with healthcare services and facilities and higher safety are positively associated with migration. On the contrary, the regression coefficient of the variable expressing satisfaction with cleanliness is negative compared to the assumption ($p < 0.1$). This result means that higher satisfaction with cleanliness is negatively associated with migration, i.e. with lower immigration or higher emigration.

Table 2 Results of regression models

	(1.1)	(1.2)	(2.1)	(2.2)
Explained variable	Migration balance per 1 ths. inhabitants in time t			
Explanatory variables				
Environmental variable	Air quality (overall satisfaction)	PM 2.5	Air quality (overall dissatisfaction)	PM 2.5
	0.058**	-0.200**	-0.061**	-0.203**
	(0.028)	(0.094)	(0.025)	(0.092)
Public transport	0.049	0.133*	-0.045	-0.077
	(0.048)	(0.077)	(0.056)	(0.106)
Health care services and facilities	0.133***	0.091	-0.066	-0.023
	(0.046)	(0.105)	(0.050)	(0.114)
Cultural facilities	-0.108	-0.108	0.034	0.022
	(0.069)	(0.104)	(0.083)	(0.113)
Cleanliness	-0.071**	-0.067	0.039	0.009
	(0.032)	(0.048)	(0.029)	(0.040)
Green spaces	0.024	-0.022	-0.039	-0.052
	(0.049)	(0.078)	(0.049)	(0.075)
Sport facilities	-0.001	0.068	0.042	0.063
	(0.046)	(0.074)	(0.063)	(0.105)
Safety	0.091*	0.124*	-0.032	-0.054
	(0.049)	(0.075)	(0.045)	(0.075)
Labour market	0.150***	0.091**	-0.150***	-0.127***
	(0.025)	(0.036)	(0.017)	(0.030)
Country	yes	yes	yes	yes
Constant	-10.363*	-7.094	19.422***	21.621***
	(5.312)	(10.978)	(4.811)	(6.346)
Overall R^2	0.3874	0.3688	0.3927	0.3748
Observations	326	210	326	210
Number of cities	70	62	70	62

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Source: Author's own calculation

In model 1.2, there is also a statistically significant variable expressing the feeling of safety ($p < 0.1$), while the regression coefficient is, as expected, positive. Another statistically significant variable is satisfaction with public transport ($p < 0.1$). A positive regression coefficient, as expected, means that higher satisfaction with this area of life is associated with a higher immigration or lower emigration of city residents. However, no other regression coefficient from the area of public services is statistically significant in model 1.2, while in models 2.1 and 2.2, whose variables represent overall unsatisfaction, no variable from the area of public services is even statistically significant. It is also worth noting that while the variables representing the state of the air (both subjectively and objectively measured) are statistically significant, satisfaction with green spaces does not explain migration. It can be summarized that higher satisfaction with public services such as health care services and facilities, public transport and higher safety can be considered as a pull factor of migration, while dissatisfaction with public services does not act as a push factor.

The labour market variable is statistically significant in all models. Specifically, in models 1.1 ($p < 0.01$) and 1.2 ($p < 0.05$) the regression coefficient is positive as expected, which means that the perceived availability of job opportunities supports immigration. In models 2.1 and 2.2 (both $p < 0.01$), the regression coefficient is negative as expected, which means that the perceived unavailability of job opportunities supports the emigration of residents. This result is consistent with traditional migration theories, especially with neoclassical theories or dual labour market theory (Massey et al., 1993), and empirical research that is devoted to the issue of migration and the state of the labour market (i.e. Pakši et al., 2023). Unavailability of job opportunities (or unemployment) can act as a push factor for migration, available jobs can act in the opposite direction on immigration to the given cities.

While the variables representing satisfaction with public services were statistically significant only rarely (and in the case of dissatisfaction even not at all), the variables representing subjective satisfaction with the air, objectively measured pollution and the state of the labour market were statistically significant in all models. It turns out that migration is mainly explained by economic and environmental factors, while the quality of public services does not play a fundamental role in migration.

V. Conclusion

The aim of this paper was to determine the factors of migration at the level of European cities. To explain the migration balance per 1 ths. inhabitants, variables that represent the satisfaction (or unsatisfaction) of the respondents - city residents with different areas of life in these cities were used. We proved that migration can be explained by subjective assessment of quality of life as well as traditionally used hard data.

It turns out that perceived air quality as well as objectively measured pollution explains migration in European cities. Higher levels of dissatisfaction with air and higher levels of air pollution are negatively associated with migration, and, on the other hand, higher levels of satisfaction with air are positively associated with migration. The air quality thus can be considered both a pull and a push factor for migration. In the same way, the state of the labour market can be considered as both a pull and push factor for migration at the level of European cities, as higher perceived availability of job opportunities encourages immigration, and on the contrary, a higher perceived unavailability of job opportunities encourages emigration of city residents. These results are in line with expectations and studies that have been conducted on these topics.

Some variables of public services such as health care services and facilities, public transport and safety appear to be a possible pull factor for migration, as respondents' higher satisfaction with these areas of life is positively associated with migration. However, these results were rare, as the regression coefficients of these variables were mostly statistically insignificant.

It turns out that the state of the labour market and air quality play a more significant role for migration than public services. Thus, the management of cities can, in the battle with the outflow of residents (and to support immigration), take such steps that support the development of business environment, the creation of new job opportunities, the reduction of pollutant emissions and thus the improvement of air quality. To support immigration, the management of cities can also take care of quality and accessible health care services and facilities, public transport and support the maintenance or improvement the safety in the cities.

A limitation of this research is that the subjective evaluation of public services does not distinguish whether and in what proportion these services are offered by the public or private sector. The subjective assessment also does not distinguish between quantity, quality or geographical availability of public services. It would be appropriate to supplement this research with objective data (e.g. number of cultural facilities, area of green spaces in ha), while the creation of such a database can be part of future research.

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References

Arif, I., Hoffer, A., Humphreys, B. & Style, M. (2022). New sports facilities do not drive migration between US cities. *Economics of Governance*, 23, 195–217. https://doi.org/10.1007/s10101-022-00271-4

Balcar, J. & Šulák, J. (2020). Urban environmental quality and out-migration intentions. *The Annals of Regional Science*, 66, 579–607. ISSN 0570-1864. https://doi.org/10.1007/s00168-020-01030-1

Bansak, C., Simpson, N. & Zavodny, M. (2021). *The Economics of Immigration*. 2. vol. London: Routledge, Taylor & Francis Group. ISBN 978-0-367-43442-7.

Basile, R., Mantuano, M., Girardi, A. & Russo, G. (2019). Interregional Migration of Human Capital and Unemployment Dynamics: Evidence from Italian Provinces. *German Economic Review*, vol. 20. https://doi.org/10.1111/geer.12172

European Commission - EC (2007). *Survey on perceptions of quality of life in 75 European cities*. Retrieved April 1, 2021, from https://ec.europa.eu/regional_policy/policy/themes/urban-development/audit_en

European Commission - EC (2010). *Survey on perceptions of quality of life in 75 European cities.* Retrieved April 1, 2021, from https://ec.europa.eu/regional_policy/policy/themes/urban-development/audit_en

European Commission - EC (2013). *Quality of life in cities: Perception survey in 79 European cities.* Retrieved April 1, 2021, from https://ec.europa.eu/regional_policy/policy/themes/urban-development/audit_en

European Commission - EC (2016). *Quality of Life in European Cities.* Retrieved April 1, 2021, from https://ec.europa.eu/regional_policy/policy/themes/urban-development/audit_en

European Commission - EC (2020). *Report on the Quality of life in European cities.* Retrieved April 1, 2021, from https://ec.europa.eu/regional_policy/information-sources/maps/quality-of-life_en

European Environmental Agency – EEA (2021). Air quality statistics - expert viewer. Retrieved April 1, 2021, from https://www.eea.europa.eu/data-and-maps/dashboards/air-quality-statisticsexpert-viewer

European Environmental Agency – EEA (2019). *Healthy environment, healthy lives: how the environment influences health and well-being in Europe*. Retrieved February 1, 2021, from https://www.eea.europa.eu/publications/healthy-environment-healthy-lives

Eurostat (2021a). *Database: General and regional statistics: City statistics: Cities and greater cities.* Retrieved April 1, 2021, from https://ec.europa.eu/eurostat/web/main/data/database

Eurostat (2021b). *Database: General and regional statistics: Perception survey results*. Retrieved April 1, 2021, from: https://ec.europa.eu/eurostat/web/products-datasets/-/urb_percep

Gray, C. L. & Mueller, V. (2012). Natural disasters and population mobility in Bangladesh. In: Clark, William A. V. (ed.). *Proceedings of the National Academy of Sciences of the United States of America*, 109, 6000–6005. https://doi.org/10.1073/pnas.1115944109

Jennissen, R. (2003). Economic Determinants of Net International Migration in Western Europe. *European Journal of Population*, 19, 171-198. https://doi.org/10.1023/A:1023390917557

Kim, M. J. & Xie, X. (2019). The Impact of Ambient Air Quality on Labour Migration in China. Retrieved February 1, 2021, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3362246

Massey, D. S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A. & Taylor, J. E. (1993). Theories of International Migration: A Review and Appraisal. *Population and Development Review*, 19(3), 431-466. ISSN 1728-4457.

Mayda, A. M. (2010). International migration: a panel data analysis of the determinants of bilateral flows. *Journal of Population Economics*, 23, 1249-1274. ISSN 0933-1433. https://doi.org/10.1007/s00148-009-0251-x

Mikula, Š. & Pytliková, M. (2020). Air Pollution & Migration: Exploiting a Natural Experiment from the Czech Republic. *EconPol WORKING PAPER No. 43*. Retrieved February 1, 2021, from https://www.econpol.eu/publications/working_paper_43

Pakši, D., Vontroba, J. & Šimek, M. (2023). Regional Migration in the Czech Republic: Economic Factors Are the Key. *Politická ekonomie*, 71, 267-290. https://doi.org/10.18267/j.polek.1386

Ravenstein, E. G. (1885). The Laws of Migration. *Journal of the Statistical Society*, 48, 167-235. https://doi.org/10.2307/2979181

Sicard, P., Agathokleous, E., De Marco, A., Paoletti, E. & Calatayud, V. (2021). Urban population exposure to air pollution in Europe over the last decades. *Environmental Sciences Europe*, vol. 33. ISSN 2190-4715. https://doi.org/10.1186/s12302-020-00450-2

Sørensen, J. F. L. (2008). The potential migration effect of rural hospital closures: A Danish case study. *Scandinavian Journal of Public Health*, 36, 460-466. https://doi.org/10.1177/1403494808089554

Sun, D., Liu, Y., Zhang, J., Liu, J., Wu, Z., Liu, M., Li, X., Guo, X. & Tao, L. (2021). Long-term effects of fine particulate matter exposure on the progression of arterial stiffness. *Environmental Health*, vol. 20. ISSN 1476-069X. https://doi.org/10.1186/s12940-020-00688-6

Torres-Reyna, O. (2007). Panel Data Analysis Fixed and Random Effects using Stata. *Princeton University*. 12/2007. Retrieved April 1, 2021, from https://www.princeton.edu/~otorres/Panel101

Xu, X. & Sylwester, K. (2016). Environmental Quality and International Migration. *Kyklos*, 69(1), 157–180. https://doi.org/10.1111/kykl.12107

Appendix

Table A Multicollinearity test (VIF)

	(1.1)	(1.2)	(2.1)	(2.2)
Explained variable	Migration balance per 1 ths. inhabitants in time t			
Explanatory variables				
Air quality	1.78	-	1.87	-
PM 2.5	-	1.18	-	1.26
Public transport	2.44	2.09	2.23	2.08
Health care services and facilities	1.84	1.49	1.65	1.40
Cultural facilities	2.72	2.54	2.52	2.20
Cleanliness	3.10	2.63	2.99	2.57
Green spaces	3.71	3.07	3.69	2.88
Sport facilities	2.20	1.84	2.69	2.14
Safety	1.68	1.85	1.55	1.78
Labour market	1.45	1.58	1.57	1.68

Source: Author´s own calculations

Table B Sample of cities

Aalborg	Cardiff	Ljubljana	Oslo	Stockholm
Amsterdam	Cluj	Lille	Ostrava	Strasbourg
Antwerp	Copenhagen	Lisbon	Oulu	Tallinn
Barcelona	Dortmund	London	Oviedo	Turin
Belfast	Essen	Liège	Paris	Verona
Berlin	Gdansk	Luxembourg	Palermo	Vienna
Bialystok	Geneva	Madrid	Piatra Neamț	Vilnius
Bologna	Glasgow	Malaga	Prague	Warsaw
Bordeaux	Gratz	Malmö	Reykjavik	Zagreb
Braga	Groningen	Manchester	Rennes	Zurich
Bratislava	Hamburg	Marseille	Riga	
Brussels	Helsinki	Miskolc	Rome	
Budapest	Kosice	Munich	Rostock	
Bucharest	Krakow	Naples	Rotterdam	
Burgas	Leipzig	Newcastle	Sofia	

Source: Author