FULL ARTICLE

The local-level impact of human capital investment within the EU cohesion policy in Poland

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Abstract

The goal of this study is to examine the effects of investment in human capital, as funded by EU cohesion policy, on economic development in Poland at the local (LAU 2) level, that is, at the level of municipalities. We found evidence that human capital investment has a positive effect on local revenues. This effect is stronger than what is observed for the assistance programmes not related to human capital. The impact of intervention on migration balance is in turn not significant. We also observed that the effectiveness of the assistance within the cohesion policy depends on existing regional preconditions for development.

KEYWORDS

cohesion policy, human capital, local development, spatial regression

JEL CLASSIFICATION R11, R58

1 | INTRODUCTION

Studies on the effectiveness of external financial aid in promoting the socio-economic development of lagging areas constitute a prominent area in the empirical literature. One strand of this literature, recently gaining importance,

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refers to the role of investment in human capital as a factor of growth and economic prosperity. European research also gives much attention to the role of the EU's cohesion policy as a powerful instrument of public intervention which, among other goals, is used to strengthen the human capital potential of regions.

Although empirical research on the outcomes of cohesion policy is rich and growing, it is far from arriving at universally shared conclusions. The results range from those showing a strong positive effect on socio-economic indicators and economic convergence (Fiaschi et al., 2018; Maynou et al., 2016), through to conditional and limited impact (Fratesi & Wishlade, 2017; Rodriguez-Pose & Fratesi, 2004). Clearly, there is a need for further evidence and new analytical approaches to shed more light on the effectiveness of EU cohesion policy in general, and the programmes in support of human capital development in particular.

The primary goal of this study is to examine the effectiveness of investment in human capital as funded by one of the cohesion policy programmes implemented in Poland between 2007 and 2015, namely, the Human Capital Operational Programme (POKL). Some of the previous research on the outcomes of cohesion policy in European regions suggests that spending funds on human capital is the most effective way for promoting economic growth (Cuaresma et al., 2018; Rodriguez-Pose & Fratesi, 2004). We attempt to verify the effects of investment in human capital by referring to the largest concluded operational programme funded by the EU's European Social Fund. Differently from the majority of earlier works, our analysis is focused on the local (LAU 2) level, that is, at the level of municipalities. There are several reasons why such an approach is worthwhile. First, although the aims of the whole cohesion policy are defined and benchmarked mostly at the regional level, a large share of the assistance is absorbed at the local level. Independent of the average impact on the regional economy, this intervention may result in either the polarization or the convergence of development and economic activity within regions. It is important to understand whether the money spent to strengthen local human capital potential contributes to cohesion at the regional scale.

As a matter of fact, only a few studies on the effectiveness of cohesion policy have looked at the local scale (below NUTS 2), for example, Churski et al. (2016) and Gorzelak (2014) for Poland, Giua (2017) for Italy, Caldas et al. (2018), Fratesi and Perucca (2019) for EU regions. Part of the reason for such deficiencies could be the problem with data availability in the past. Today the situation has improved significantly and this study's findings benefit from the database of individual projects within all cohesion policy programmes in Poland, as well as from the database of individual beneficiaries of the POKL programme.

Another contribution of our research to the state of the art relies on comparing the effectiveness of investment in human capital between different types of regions in the same country. We have carefully heeded the postulates resulting from earlier studies, namely, the need to contextualize the research on cohesion policy, and in particular the need to take into account the preconditions for socio-economic development in different regions (Fratesi, 2020). POKL is a perfect subject for such investigation, as its major part is initially distributed between the regions (voivodeships) based on a centrally imposed algorithm, and then allocated to beneficiaries based on the regions' own policies and priorities (see the Appendix for details). Moreover, Polish regions are very diversified in terms of sectoral economic structure, labour market conditions, and degree of urbanization. This opens the possibility of assessing the outcomes of intervention in the regions of different profiles, having divergent policies with respect to human capital, but sharing general institutional framework defined at the national level.

With respect to model specification we propose two innovative solutions. First, when measuring the outcome of human capital-oriented assistance programmes we decided to move away from GDP and focused on two dependent variables more coherent with the disaggregated nature of our research with the goals of the POKL programme (local own revenues, and net migration). Second, we use a spatial panel model to capture the territorial spillovers resulting from intervention. Although spatial correlation has been used in some earlier studies on the effectiveness of cohesion policy, this is the first time it has been applied at the local level, where it seems more relevant than in the regional- or country-level investigations.

Finally, and importantly, this research is based on the unique dataset developed from the database of individual projects within all cohesion policy programmes in Poland, and from the database of individual beneficiaries of the POKL programme. In order to use this data in our research we applied a self-designed procedure to approximate the

ciaries residing in each municipality (see subsection 3.1).

municipal-level absorption of cohesion policy funds between 2007 and 2015, based on the actual number of benefi-

The rest of this work is organized as follows: Section 2 provides a review of the literature on EU cohesion policy and the role of human capital. Here we summarize the findings and identify the research gaps. In Section 3 we discuss the methodology and data used throughout the analysis. Section 4 offers the results of the study, starting with the assessment of the allocation of POKL funds among municipalities, then moving to the impact of POKL on local revenues and migration. The final section of the article includes a discussion of our findings.

In order to limit the length of the article, we decided to present a detailed description of the POKL programme and related statistics in the Appendix, instead of including them in the main text.

2 | COHESION POLICY, HUMAN CAPITAL, AND REGIONAL DEVELOPMENT

Cohesion policy is the EU's investment programme that supports regional development. It aims at reducing the economic, social, and territorial disparities between the EU regions, channelling investments via three main funds, namely, the European Regional Development Fund, the European Social Fund, and the Cohesion Fund (European Commission, 2007). The architecture of the cohesion policy evolves with subsequent programming periods. In this paper we focus on the 2007–2013 period, the most recently finalized one. In the 2007–2013 EU budget, cohesion policy received ϵ 347 billion (2007 prices) which accounted for 35.7% of total allocations, compared to 32.5% in the 2014–2020 period (European Commission, 2007, 2014). Over 81% of these funds were directed to the convergence objective, to stimulate growth and employment in the least developed regions and member states. Poland received approximately ϵ 67.3 billion under the 2007–2013 cohesion policy, making it the largest beneficiary among all member states. All ESF funds allocated for Poland have been channelled via the Human Capital Operational Programme (POKL), with a budget of ϵ 10 billion. Such an unprecedented level of investment warrants in-depth analysis of its effects, especially in that cohesion policy researchers have not agreed to date on whether the EU investments are a guarantee of development.

Studies on the effectiveness of EU cohesion policy in stimulating regional economic growth and development provide a wide array of results. First, there are studies proving its effectiveness. For instance, Maynou et al. (2016) concluded that the Structural and Cohesion Funds in the Eurozone between 1990 and 2010 led to conditional regional convergence. Fiaschi et al. (2018) and Mohl and Hagen (2010) argue that the least developed regions (Objective 1 regions) are the ones benefiting the most from the cohesion policy. According to Bradley (2006), among the less developed regions the biggest multiplier effects occur in Spain and Poland.

Positive impact of cohesion policy on growth of Objective 1 regions has also been proven by Becker et al. (2010). Analysing data on European NUTS 2 and NUTS 3 regions (1989–2006) through regression discontinuity design (RDD), this study showed a positive impact of cohesion policy on regional growth, but not on employment. Similar results, proving the effectiveness of Objective 1 funds on regional economic growth, have also been reached by Pellegrini et al. (2013) who applied RDD to NUTS 2-level data covering 15 EU Member States in the years 1995–2006. In turn, Giua (2017) found that EU regional policy positively impacts employment, particularly in manufacturing, tourism and retail—sectors especially important for long term regional development.

Although a significant number of studies provide a positive evaluation of cohesion policy, many researchers argue that its effectiveness is conditional at best. It turns out that the outcomes depend on many characteristics of the regions covered by the assistance. Therefore, both the policy and the research on it need to be "contextualized" (Fratesi, 2020). Some studies prove that the outcomes of intervention are determined by the quality of institutional environment (Ederveen et al., 2006; Fratesi & Wishlade, 2017; Rodríguez-Pose & Garcilazo, 2015). Medeiros's (2014) research on Portugal's spending of cohesion policy funds shows that although investments were to some degree successful, the country needs better spatial planning and an improved development strategy to coordinate spending. Aiello et al. (2019), in their study of 2007–2013 cohesion policy in the Emilia-Romagna and Calabria regions in Italy,

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show that regional political context and administrative capacities impact how LMAs implement cohesion policy. Bähr (2008) points to another aspect of regional institutional context suggesting that that the more decentralized the state, the more effective cohesion policy will be. It might not only be just the quality of governance in general, but a question of what level of governance manages cohesion funds and the capacity of local and regional authorities (Bähr, 2008; Szabo, 2016). Finally, recent findings of Fratesi and Perucca (2019), as well as of Di Cataldo and Monastiriotis (2020) support the idea of targeting the assistance to regional needs, and of investing in areas that are "complementary" to the tangible or intangible assets that the regions already have.

Some authors go further in their criticism of the EU's cohesion policy, claiming that European funds support the improvement of quality of life rather than long-term development. This attitude is particularly common in the Polish literature of the subject (Gorzelak, 2014; Kozak, 2014, Churski et al., 2016).

Of particular interest for our considerations is any evidence concerning the possible impact of the cohesion policy's human capital investments on regional development in European countries. Apart from the already mentioned Europeanwide research by Rodriguez-Pose and Fratesi (2004) and the Portuguese study by Medeiros (2014), another work of the latter author also demonstrates the effectiveness of human capital investments within cohesion policy (Medeiros, 2017). However, there is also evidence for the minor importance of human capital investments for regional development. Looking at the period 2000–2014 of EU funding for Portuguese municipalities, Caldas et al. (2018) showed that human capital investments, here called human potential (investments in training and school education, infrastructure in education) did not ultimately contribute to "municipality sustainability" as much as other types of investments. The possible minor effect of cohesion policy has also been demonstrated by a microeconomic study in the Czech Republic by Pelucha et al. (2019). This analysis focused on training schemes funded by the European Social Fund for the years 2006–2012. Both qualitative and quantitative methods showed that training itself did not impact an enterprise's development as much as other factors such as time on the market or internal issues such as the attitude of employees towards training.

As it results from the review presented in the previous paragraphs, the effects of EU cohesion policy on regional economic performance is thoroughly studied, even if the conclusions from these studies are mixed. A much less investigated issue is the impact of cohesion policy on the mobility of human capital. Public intervention aimed at improving the quality of human capital may be beneficial for the region in terms of income or productivity measures, but it does not necessarily mean that the gains will be preserved for the locality in which the investment actually takes place. Since individuals who are well-endowed with human capital tend to migrate from less developed economies to more affluent ones, the first intuition is that their migration contributes to the widening of the human capital gap between the donor and destination areas. Even though the importance of this effect, frequently referred to as "brain drain," is less pronounced in the cohesion policy discourse, it has historically dominated the academic literature on migration. As shown by empirical studies in this matter, two fundamental factors behind the migration decisions are: employment opportunities (Delisle & Shearmur, 2010; Haapanen & Tervo, 2011), and wage premium (Di Cintio & Grassi, 2013; Faggian & McCann, 2007; Kodrzycki, 2001). At the same time, the higher the class of qualification obtained, the higher the probability of migrating (Faggian et al., 2006; Ishitani, 2011; Mosca & Wright, 2010; Ritsila & Ovaskainen, 2001). In the European reality, the migration of human capital usually favours large metropolitan areas (Faggian & McCann, 2009; Hoare & Corver, 2010).

Taking these results into account, investing in human capital may be a good strategy to assist the residents of economically lagging areas, as it potentially contributes to raising incomes, but at the same time it may not be optimal from the point of view of territorial cohesion, since it stimulates the outflow of the skilled labour force from the peripheries. This hypothesis will be tested in the following sections of this paper based on analysis of the local impact of human capital investment within EU cohesion policy.

3 | CONCEPTUAL FRAMEWORK & DATA

Since the seminal work of Krugman (1991), there is a growing interest in exploring territorial inequalities of development at the sub-national level, and the effectiveness of policies addressing this issue. The growing impetus of metropolization, urban sprawl, urbanization, and other processes driving territorial heterogeneity necessitate analyses at finer spatial scales. However, while data on the regional distribution of cohesion-policy funds is relatively easily accessible, assessing local cohesion-policy investments is much more challenging. By shedding light on the local distribution of these funds we aim to explore the mechanisms of local development, focusing on the role of human capital investments.

The notion of local development itself requires operationalization. Economic literature usually refers to GDP *per capita* as a universal measure of prosperity. Although this approach is increasingly contested, particularly since the influential report by Stiglitz et al. (2009), the income-related measures of economic performance are commonly used, as they allow researchers to capture many dimensions of human well-being. One disadvantage of GDP in the context of our work is that it is not available for the territorial units below the NUTS 3 level (according to the Eurostat classification). Since we operate at the LAU 2 level (municipalities), GDP is not an option.

Perhaps even more importantly, it is not clear whether an increase of people's income or productivity can be considered the major or sole goal of the POKL. As mentioned earlier, the official documentation of the programme refers to such notions as human resources, adaptiveness, health, or education. One might also refer to the general definitions of human capital that most frequently involve people and qualifications determining their productivity, and thus income (Goldin, 2016). However, cohesion policy is clearly aimed at helping lagged territories, not just its inhabitants. Strengthening the local human capital potential will only work if this capital remains local, which returns us to the question whether the human capital investment supports brain gain more than in stimulates brain drain.

Our approach to operationalize the expected outcome of investment in human capital, as derived from the literature review in the previous section and from the methodological considerations in the previous paragraph, is twofold. First, we use the own revenues of municipalities *per capita* as a proxy for local wealth. Our measure includes the local share in personal income tax, corporate income tax, property tax, agricultural tax, as well as many other revenues related to the economic activity of local individuals, households, and companies. It does not include any transfers received by the local authority from the central budget. Own revenues *per capita* seem to be a good measure of the autonomous economic potential of a municipality, and they have been used as a local counterpart of GDPrelated measures in a number of studies on local economic development in Poland (Herbst & Wójcik, 2013; Smętkowski et al., 2009).

Second, we assume that a successful programme in support of human capital should have a significant impact on the local migration balance. If the impact is positive, then we can speak of success in "territorial" terms, as apparently the intervention contributes to improving life and work conditions in a given locality, thereby persuading residents to stay as well as attracting newcomers (in the spirit of Tiebout, 1956). If, however, the effect of the programme on net immigration is negative, we may interpret this as an improvement in the individual level of human capital leading to an increased outmigration of skilled individuals in search of better opportunities. In such a case the interest of individual beneficiaries of the programme, and the interest of the whole community, will be in conflict.

3.1 | Data

The source of dependent variables—change in local productivity and population change—was the Bank of Local Data (BDL) maintained by Poland's Central Statistical Office. These two variables are available at the municipal level, that is, for each of the 2,478 Polish municipalities (gmina). As one of the municipalities was excluded from the analysis due to missing data, the total number of (cross-section) observations was 2,477, and our data covered the years from 2007 to 2015.

The construction of the explanatory variables required more specialized data. We use the administrative database of individual projects implemented in Poland within the ESF 2007–2013, and namely its monitoring subsystem (PEFS). PEFS was set up as a single database, integrating the personal information of all¹ participants of the POKLfunded projects. The anonymized PEFS database was acquired from the Polish ESF Managing Authority in 2016,

with data as of the end of 2014. It contains 8.78 million records on beneficiaries of the POKL programme, out of which 83% are individual participants (enrolled in an ESF-funded project), and the remaining 17%—institutional participants (enrolled in an ESF-funded project as a member of a beneficiary institution). Interestingly from the view-point of our research, each record contains a post code address of the participant,² and an ID of the project. The latter allows us to link PEFS records with the database of all CP projects implemented in Poland, and to estimate the average value of investments per person per project. Finally, using individuals' post codes, we aggregate the estimated value of POKL subsidies at the municipal (LAU 2) level.

While the PEFS database allowed us to approximate the local distribution of the POKL funds based on the number of individual beneficiaries, the situation was different in the case of the non-POKL funding within the cohesion policy, as here we had access only to the project-level data. The local distribution of these funds was then calculated based on the population levels of the municipalities affected by particular projects. The municipal share in projects covering an area larger than one municipality was assumed to be proportional to the share of its population in the total population of the covered area.

3.2 | Spatial panel model with municipal fixed effects

In order to assess the effect of investment in human capital on local development we apply a panel regression model with municipal fixed effects and spatial correlation. The period of the POKL's implementation (2007–2015) was divided into four 2-year subperiods—2007–2009,³ 2010–2011, 2012–2013 and 2014–2015. The reason for aggregating the yearly figures into 2-year periods is that our data do not allow us to precisely assess the time of the intervention (fund transfer). We approximate it based on the year in which the project was concluded. Using 2-year aggregates helps to correct for the imprecision of such measurement.

Following the famous Tobler's (1970) first law of geography, the attempt to assess the effects of cohesion policy funds on local development should assume that the investigated phenomena are spatially correlated. First, the economic performance of a municipality clearly depends not only on local resources and activities, but also on the condition of the nearby municipalities which may provide labour opportunities, purchasing power, and create various types of spillover effects reaching beyond their administrative borders. Second, the impact of investment in human capital on local development (which is the main effect of interest here) is also likely to be spatially lagged, as any project implemented in one municipality may affect the performance of neighbouring communities. Spatial spillovers in the data render traditional OLS estimators ineffective and biased, thus inviting the use of spatial econometrics. The latter has only recently become a point of interest in cohesion fund literature (Dall'Erba & Fang, 2017), but has already proven useful (Bourdin, 2019).

Finally, the spatial correlation may also result from the approach we utilize to disaggregate the value of cohesion policy investment on the local level. Depending on the type of programme in question, we assume that the individual municipal share in projects spanning several municipalities is proportional to either the number of local participants in the total number of the given project's participants (POKL), or to the share of local population in the total population covered by the project (see subsection 4.3 for details). Both approaches may be imprecise and lead to either an overestimation or underestimation of the given municipality's monetary benefits from the project. Such bias may differ across projects, with its scale and direction remaining unknown. Accounting for spatial correlation in the data will help to correct this unknown measurement error.

By applying a spatial panel model our study feeds into the growing popularity of spatial econometrics used for cohesion policy studies (Dall'Erba & Fang, 2017). Increased usage of such methods stems from the fact that they enable researchers "to proxy for interregional backward and forward linkages, technology spillovers, commuting across regions, and to refute the traditional assumption of independence of the error terms" (Dall'Erba & Fang, 2017, p. 825). An example of such an approach can be found in Mohl and Hagen (2010), where the spatial panel approach was used to take into account spatial spillovers. Maynou et al. (2016) built upon this by combining the spatial and

temporal perspectives in the Bayesian approach, while Fiaschi et al. (2018) analysed spatial externalities of funding in the spatial Solovan model. Other examples worth mentioning are studies by Dall'Erba et al. (2010) who used Verdoon's law and spatial econometrics to analyse the impact of structural funds on manufacturing sector in EU regions and Bouayad-Agha et al. (2013) who applied the spatial dynamic panel data model to confirm the positive impact of cohesion policy on Objective 1 regions.

In order to verify the presence of spatial correlation we performed a standard Moran *I* test (Moran, 1950) following the cross-sectional regression based on the specification from subsection 4.1, and data limited to the last of the three time periods. The null hypothesis of spatial independence was rejected with p < 0.01. We therefore decided to estimate a spatial model (Anselin, 1988) including the spatially lagged dependent variable, spatially lagged variable, and the spatially lagged error. Thus, we opted for a "full model," also called a Manski model. The rationale for this strategy is that in any research regarding the impact of public intervention on local economic development both spatial spillovers of development itself (dependent variable), and externalities created by the intervention are very likely. Our approach is similar to that used by Bourdin (2019), who investigated the effects of cohesion policy on regional growth taking into account both the spatial dependence related to the explained variable and to exogenous variables.

The specification of the model takes the following form:

$$\begin{aligned} \Delta \mathbf{y}_{t} &= \beta_{0} \mathbf{i}_{N} + \beta_{1} \mathbf{y}_{t-1} + \lambda \mathbf{W} \Delta \mathbf{y}_{t} + \beta_{2} \operatorname{coh}_{f} \operatorname{fund}_{t} + \varphi \operatorname{Wcoh}_{f} \operatorname{fund}_{t} + \eta + \varphi_{t} \mathbf{i}_{N} + \mu_{t} \\ \mathbf{y}_{t} &= [\mathbf{y}_{1t}, \mathbf{y}_{2t}, ..., \mathbf{y}_{Nt}]' \\ \operatorname{coh}_{f} \operatorname{fund}_{t} &= [\operatorname{coh}_{f} \operatorname{fund}_{1t}, \operatorname{coh}_{f} \operatorname{fund}_{2t}, ..., \operatorname{coh}_{f} \operatorname{fund}_{Nt}]' \\ \eta &= [\eta_{1}, \eta_{2}, ..., \eta_{N}]' \\ \mu_{t} &= [\mu_{1t}, \mu_{2t}, ..., \mu_{Nt}]', \end{aligned}$$
(1)

where: $y_t = \langle rev_t | migr_t \rangle$ represent either own revenues *per capita* of a municipality in period *t*, or the net immigration to this municipality per thousand inhabitants in period *t*, depending on the variant of estimation. *coh_fund*_t is the amount of POKL funds *per capita* absorbed by a municipality in period *t*. η is municipal fixed effect, φ_t is the fixed effect of the period, μ_t is the spatially lagged error, W represents the spatial weighting matrix. The specification also includes the level of the revenue (or population) in period *t*-1. This way, we follow the typical specification of betaconvergence model.

Regarding our approach to spatial correlation in the model, we calculate the spatial effects using a rowstandardized inverse-distance weighting matrix (Darmofal, 2015).¹ The weights are inversely proportional to the distance between municipalities, and the impact is "truncated" when the distance reaches 50 km. To get consistent parameter estimates in case of a dynamic panel with fixed effects and small T and avoid the so called Nickell bias we applied the spatial generalized method of moments estimator (GMM) based on the full set of moments conditions (Arellano & Bond, 1991; Kapoor et al., 2007), which has good small sample performance (Elhorst, 2010). Total, direct, and indirect impacts (LeSage & Pace, 2009) were assessed in post-estimation procedure."

3.3 | Sensitivity checks (variant analysis)

Although the specification shown in Equation 1 is our base model, in order to test the robustness of our results, as well as to verify certain assumptions which we "borrow" from the existing literature of the subject, we introduce several variants of estimation in the course of our analysis.

First of all, as defined in the previous section, the main explanatory variable, *coh_fund*_t, reflects the amount of human POKL funds absorbed by given municipality in period *t*. However, in the part of the analysis relying on pooled data on all Polish municipalities (subsection 4.2) the estimation is repeated using three different variants of the

coh_fund variable, referring respectively to the regional component of POKL, the central component of POKL, and all cohesion policy funds excluding the POKL:

 $coh_fund_t = \langle POKL_reg_t | POKL_centr_t | OTHER_t \rangle.$

Our intention was to check whether the outcomes of such alternating estimation confirm the findings of other researchers, namely, that strengthening human capital potential has a greater impact on regional economic performance compared to other forms of assistance (Medeiros, 2014, 2017; Rodriguez-Pose & Fratesi, 2004), and that decentralized administration of the assistance programmes yields better results compared to centralized ones (Bähr, 2008).

A second line of sensitivity testing was related to the concept of neighbourhood within our spatial regression analysis. We were considering (and testing) different variants of contiguity, and distance-based weighting matrices, including neighbours of the 1st, 2nd, and 3rd order, as well as a different point of truncation. Ultimately, rather than referring to neighbours as contingent territories, we decided to apply the concept of neighbourhood that corresponds to functional interdependence of smaller administrative units within agglomerations or other functional areas.

Finally, we experimented with time lag. Equation 1 is based on the assumption that the hypothetical impact of cohesion policy is simultaneous to the intervention, that is, it takes place within the same 2-year period. However, it seems probable that the intervention initially has a negligible effect on the local economy, but it yields a stronger impact in the following time period. This may happen for either technical, or more substantive reasons. First, the time of intervention is assessed with limited precision, as the assessment is based on the flow of funds. When the intervention actually starts to "work" depends on many characteristics of particular projects, characteristics that we do not observe in our research. Even more importantly, the lag may result from the fact that it takes more time to trigger the supply factors stemming from the intervention, than it is needed for demand factors to reveal. Investment in human capital may result with higher productivity of labour and higher employment rate, which only over time would lead to higher revenues. The assistance unrelated to human capital (e.g., infrastructural projects) can reduce various types of transactions costs, but again, it does not happen immediately after the funds are transferred. This allows us to understand whether the observed effects are persistent, or if they only induce a disposable change of dependent variables, but no longer time impact.

Because of these uncertainties, we run our estimation in two variants: one assuming immediate effects of intervention, and one in which the cohesion policy variable is lagged by one time period. In the latter case, the delay in the supposed impact refers to both direct, and indirect effect of the intervention:

$$\Delta \mathbf{y}_t = \beta_0 \mathbf{v}_N + \beta_1 \mathbf{y}_{t-1} + \lambda \mathbf{W} \Delta \mathbf{y}_t + \beta_2 \operatorname{coh}_{\text{fund}_{t-1}} + \phi \mathbf{W} \operatorname{coh}_{\text{fund}_{t-1}} + \eta + \varphi_t \mathbf{v}_N + \mu_t.$$
(2)

All the results in Tables 2 and 3, and in Figures 4 and 5 are shown separately for the "simultaneous" and "lagged" specifications.

3.4 | Regional models

In the case of the regional component of the POKL programme, the distribution of funds was subject to regional policies. The voivodeship authorities were to a large extent autonomous in terms of setting the eligibility criteria and rules of competition, defining priorities, establishing subprogrammes, etc. This suggests that the impact of the programme might have differed substantially between regions. Unfortunately, we do not have enough information to analyse in detail each of the 16 regional approaches, and even if it was possible, the outcome would certainly exceed the scale of one journal paper. However, it is also important to realize that in the middle of the new millennium's first decade, at the launch of POKL, Polish regions (voivodeships) were quite diversified in terms of the preexisting conditions for economic development. One way to look at these differences, common in Polish literature, is the historical division into the urbanized and industrialized West versus the underdeveloped East, the latter characterized by the persistency of traditional, small-scale farming and delayed urbanization (Gorzelak, 2007; Gorzelak & Jałowiecki, 2000).

Although the East–West opposition is well established in Polish regional studies, it is important to understand the preconditions for regional development in more detail. In the context of cohesion policy, it seems particularly worthwhile to emphasize three factors, of which two were implicitly included in the algorithm to divide the POKL funds between voivodeships (as discussed in the Appendix). First, the regions differ in terms of the level of urbanization. In some of them there are metropolitan cities with populations greater than 500,000 which act as "growth poles" and labour market centres. Other regions do not have an agglomeration with a population exceeding 200,000. Second, the economic transformation of the 1990s left many regions of Poland with a high level of structural unemployment. This applied particularly to the northern and western parts of the country, suffering from the collapse of the state-operated farms, and to industrial centres, like Łódź, or the Silesian agglomeration, where many state-owned factories went bankrupt in the last decade of the 20th century as a result of the opening of Poland's economy. Finally, regions in Eastern Poland were characterized by the very traditional sectoral structure of their economies, with a large number of small agricultural farms mostly satisfying their own consumption needs.

Based on the aforementioned characteristics of voivodeships (shown in more detail in Table 1), we propose a simple typology of Polish regions in order to provide valuable context for discussing the results of estimations.

We divide voivodeships into four categories:

- Metropolitan regions which includes five regions with large, and economically strong cities, population of which exceeds 500,000. These are: Mazowieckie (Warsaw), Wielkopolskie (Poznań), Małopolskie (Cracow), and Pomorskie (Tri-City including Gdańsk).
- Traditionally rural regions, that is, voivodeships in which employment in the agricultural sector exceed 20% of the total figure, and which small, family-operated farms are dominant form of agricultural activity. This includes: Podlaskie, Lubelskie, Podkarpackie, and Świętokrzyskie.
- 3. Structurally burdened urban regions are areas experiencing persistently high unemployment, with large cities that also suffer from structural burden. This category includes Śląskie, Łódzkie, and Dolnośląskie

Working in agricultural sector <10% 10% > Working in		Low \rightarrow high unemployment (2005)			
agricultural sector agricultural sector	<20% Working in >20%	<15%	15-20%	>20%	
Metropolitan → Rural (2005)	Largest city < 200 k		Opolskie	Podkarpackie	
	Lubuskie Warmińsko- Mazurskie				
	200 k < Largest city < 500 k		Lubelskie Podlaskie	Kujawsko-Pomorskie Świętokrzyskie Zachodniopomorskie	
Largest city > 500 k	Mazowieckie Wielkopolskie Małopolskie	Łódzkie Pomorskie Śląskie*	Dolnośląskie		

TABLE 1 Typology of Polish voivodeships

Source: based on data from the Central Statistical Office (GUS).

4. Structurally burdened polycentric regions with relatively high unemployment that originates from the economic transformation of the 1990s, and a number of medium-sized cities instead of one major labour market pole. This applies to Lubuskie, Zachodniopomorskie, Opolskie, Kujawsko-Pomorskie, Warmińsko-Mazurskie.

The regional allocation of POKL funds, along with the assignment of particular voivodeships according to the aforementioned typology are shown in Figure 1.

In subsection 4.3 we show the estimation results for model (6) separately for each of the categories within the proposed typology, thus obtaining a region-specific assessment of the POKL impact on local socio-economic performance.

4 | RESULTS

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4.1 | Spatial distribution of POKL funds

Taking into account the shape of the algorithm used to distribute the regional component of POKL funds between the Polish regions, it is obvious that the funds available *per capita* in particular voivodeships must have substantially differed. In fact, Figure 2, shows the estimated absorption of POKL funds *per capita* in Polish municipalities in the period 2007-2015, which clearly reflects this regional-level distribution of funds. Municipalities in the Southeast (Podkarpackie, Lubelskie, and Świętokrzyskie), as well as these in the Northern regions (Zachodniopomorskie and Warmińsko-mazurskie) are the ones with the highest absorption *per capita*.

At the same time, the municipal shares in the total assistance are quite diversified within the regions, which reflects the 16 regional policies used to distribute the assistance to the local level. In most of the regions we observe several municipalities belonging to the highest quintile according to the value of absorbed funds, but also those in the first quintile, which absorbed very little funding. Probably the most diversified region is Mazowieckie, where the



FIGURE 1 Funds assigned to voivodeships within the regional component of the POKL programme (2007–2015), in millions of EUR (left panel), and typology of voivodeships (right panel) ^a*Note*: The numbers represent the value of total assistance assigned to the beneficiaries due to implementation of the POKL projects. They include both EU funds and domestic contribution, but not the contribution of the beneficiaries. The values in EUR were calculated using the exchange rate of the National Bank of Poland from 31.12.2015 (1 EUR = 4.26 PLN)



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FIGURE 2 Estimated value of the subsidies to POKL projects *per capita* (regional component only) in 2007–2015 (PLN), by municipality, based on the place of residence of individuals participating in the projects

metropolitan area of Warsaw has received meagre funds *per capita*, whereas the municipalities in the North and South of the region are among the biggest beneficiaries of the POKL.

Figures 2 and 3 show that territorial distributions of the central component versus regional component of the POKL are very different. While the regionalized part of the programme is to a high extent focused on the voivodships facing structural problems related to their economies (see the algorithm in the Appendix), the funds within the central component are more dispersed throughout the country and the absorbed amounts *per capita* are less diversified among the municipalities.

4.2 | Results of estimation using pooled data on the municipalities from all regions

To begin the analysis, we estimated the effect of local investment in human capital on the change in local revenues and on migration, first using the non-lagged explanatory variables referring to the absorption of the EU funds, and then replacing them with their lagged equivalents. In order to properly interpret the results of the model, we will not refer to the regression coefficients, but to the direct, indirect, and total effects obtained in the post-estimation analysis.

Before we turn to the effects of cohesion policy on local development, it is worth referring to the general convergence between municipalities with respect to dependent variables in the period of consideration. Table 2 shows that we observe beta convergence in the case of both dependent variables; that is, revenues grow faster in municipalities with its lower initial value, and net migration depends negatively on initial population level. This regularity is independent of the presumed effect of cohesion policy on the explained variables. 

When we focus on the immediate (not lagged) impact of the regional component of POKL on local own revenues *per capita* (upper panel of Table 2, column (1)), we can see that cohesion policy may contribute to the observed convergence trend. Both direct and indirect effects of POKL's regional component on local revenues are statistically significant. The total effect equal to 0.08 means that a 10% increase in the absorption of cohesion funds is associated with a 0.8 percentage point increase in a municipality's revenues *per capita* in the same two-year period. The indirect effect is larger than the direct one, which suggests that the spatial scale of typical projects within the POKL programme goes beyond the area of single municipality.

The effect of regionalized POKL funds on net migration is in turn negligible. The sign by the total effect is negative (column (2) in Table 2, upper panel). Again, the spatial spillover seems to be more pronounced compared to direct intervention, but none of these effects is statistically significant. Absorbing more funds *per capita* within the regional component of the POKL programme does not help municipalities to improve their migration balance within the same time period.

Compared to the regional component of the POKL programme, the estimated "immediate" effect of the centrally distributed part of this programme on local revenues is smaller, but it remains positive and statistically significant (see column (3) in Table 2). The magnitude of the total effect is about 75% of the one observed for the regionalized funds.

The direct correlation between the intervention within the central component of POKL and the net migration is negative. A 10% increase in funding is associated with a loss of 0.02 inhabitant per 1,000 of population. Both the indirect and total effects are though insignificant.

When it comes to the impact of the non-POKL projects funded by the EU (columns (5)–(6) in Table 2), the effect of the assistance on local revenues is again positive, but smaller than the one estimated for two other types of programmes. In turn, there is no correlation between the non-POKL funds and migration, neither directly nor as a result of spatial correlation with the intervention nearby.

rect, indirect and total effects of the cohesion policy projects on local development. Results from the spatial autoregressive models with simultaneous (upper	ed (lower panel) independent variable
BLE 2 Direct, indirect an	el) and lagged (lower panel)
ΤA	pan

panel) and lagged (lower par	el) independent variable					
	POKL_regional		POKL_central		OTHER	
Cohesion policy variable	(1)	(2)	(3)	(4)	(5)	(9)
Dependent variable	△ local revenues	Net migration	△ local revenues	Net migration	△ local revenues	Net migration
	Simultaneous					
Direct	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
Revenues/population at t0	-1.346 (0.000)	-27.83 (0.000)	-1.356 (0.000)	-28.19 (0.000)	-1.345 (0.000)	-27.81 (0.000)
Cohesion policy variable	0.017 (0.011)	0.003 (0.960)	0.015 (0.076)	-0.196 (0.027)	0.007 (0.021)	-0.042 (0.212)
Indirect						
Revenues/population at t0	0.345 (0.005)	-4.227 (0.245)	0.358 (0.004)	-1.211 (0.746)	0.379 (0.001)	-4.385 (0.212)
Cohesion policy variable	0.063 (0.000)	-0.143 (0.121)	0.045 (0.000)	0.076 (0.395)	0.045 (0.000)	-0.065 (0.220)
Total						
Revenues/population at t0	-1.001 (0.000)	-32.05 (0.000)	-0.998 (0.000)	-29.40 (0.000)	-0.965 (0.000)	-32.19 (0.000)
Cohesion policy variable	0.080 (0.000)	-0.139 (0.213)	0.060 (0.000)	-0.120 (0.269)	0.052 (0.000)	-0.108 (0.088)
z	9,908	9,908	9,908	9,908	9,908	9,908
Pseudo_R ²	0.044	0.007	0.044	0.007	0.045	0.007
Dependent variable	Δ local revenues	Net migration	Δ local revenues	Net migration	Δ local revenues	Net migration
	Lagged					
Direct	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
Revenues/population at t0	-1.440 (0.000)	-37.13 (0.000)	-1.452 (0.000)	-37.21 (0.000)	-1.442 (0.000)	-36.89 (0.000)
Cohesion policy variable	0.014 (0.009)	-0.023 (0.757)	-0.006 (0.450)	0.036 (0.728)	-0.004 (0.142)	0.033 (0.394)
Indirect						
Revenues/population at t0	0.414 (0.000)	13.304 (0.063)	0.337 (0.001)	14.08 (0.056)	0.403 (0.000)	9.532 (0.195)
Cohesion policy variable	0.045 (0.000)	-0.083 (0.215)	0.065 (0.000)	-0.108 (0.180)	0.039 (0.000)	-0.093 (0.086)
Total						
Revenues/population at t0	-1.027 (0.000)	-23.83 (0.000)	-1.116 (0.000)	-23.13 (0.000)	-1.039 (0.000)	-27.35 (0.000)
Cohesion policy variable	0.060 (0.000)	-0.106 (0.197)	0.059 (0.000)	-0.073 (0.292)	0.035 (0.000)	-0.060 (0.224)
z	7,431	7,431	7,431	7,431	7,431	7,431
Pseudo_R ²	0.078	0.011	0.076	0.011	0.078	0.011
Notes: p-values in parentheses.	All specifications include fixec	l effects of municipalities ar	hd time.			

The lower panel of Table 2 includes the results of estimation with the main explanatory variable lagged by one period. It turns out that the estimated effects of EU assistance on local revenues are slightly weaker when measured with a lag, than was the case when immediate impact was measured (see lower panel of Table 2). However, the sign of the effects is unchanged. When it comes to the effects of the regional component of the POKL on local revenues *per capita*, the long-term impact is positive, and driven mostly by an indirect effect. A 10% increase in EU assistance is associated with 0.6% gain in own municipal revenue. The total effect of funds spent within the centrally operated part of the POKL programme is very similar (0.59%).

It can be observed that typical projects implemented within the central component of the POKL programme tend to have supra-local scope. Similarly to the impact of regionalized POKL, the effects of this central component on municipal economies are mostly "spatially indirect," and thus associated with the intervention in the nearby localities.

Compared to the immediate effect, the EU assistance not related to human capital appears to have a lower impact on local revenues in the lagged specification. This effect is also about 40% lower than in the case of interventions under the POKL programme. Moreover, the whole impact seems to result from the spatial correlation. While a direct association between intervention and local revenues is close to zero, the indirect effect has a positive sign and is highly significant. This supports the intuition that the impact of interventions not related to human capital should be assessed in the supra-local scale.

In contrast to the impact of non-POKL assistance on local revenues, there seems to be no association between municipalities receiving EU funding in one period and migration patterns in the subsequent period. Both direct and total effects prove to be insignificant in this case. The spatially lagged impact is only significant at $\alpha = 0.1$, while the magnitude of the respective coefficient is similar to these obtained for POKL funds.

A simple summary of the above findings from the estimation on pooled sample (all regions) is provided in Table 3.

4.3 | POKL (regional component) effect on local development by type of region

In the following section we will focus on the effects of POKL's regional component, leaving aside its centrallyadministered part, as well as other EU programmes. The reason, besides the need to limit the length of the text, is

	POKL_regional		POKL_central		OTHER	
Dependent variable	Δ local revenues	Net migration	Δ local revenues	Net migration	Δ local revenues	Net migration
Type of effect						
Direct						
Simultaneous	Positive	Not	Positive	Negative	Positive	Not
Lagged		significant	Not significant	Not significant	Not significant	significant
Indirect						
Simultaneous	Positive	Not significant	Positive	Not significant	Positive	Not significant
Lagged						Negative
Total						
Simultaneous	Positive	Not	Positive	Not	Positive	Not
Lagged		significant		significant		significant

TABLE 3 Direct, indirect and total effects of the cohesion policy projects on local development - summary

Note: The effect is labelled as not significant for p-values > 0.1.

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that in the earlier parts of this work the regional component of the POKL seemed to have stronger impact on socioeconomic indicators compared to other types of EU assistance. Naturally, we also expect more variation in regional approaches to the programme's implementation with respect to the component, which is regionally designed and administered, than in the case of centrally operated part.

The analysis is performed for municipalities within the four regional types as defined in subsection 3.4, using local own revenues *per capita* and net local migration as two dependent variables. The average impacts, calculated on the basis of the spatial autoregressive model, are shown in Table 4. However, to facilitate the interpretation of the results, we also present the comparison of total impact parameters with respect to both immediate and lagged effect (light and dark bars respectively) in Figures 4 and 5. The outcomes reveal substantial differences in the cohesion policy's effectiveness between the types of regions. Looking at the coefficients, all four categories of regions show a positive effect of investment in local human capital on local revenues, both simultaneously to the intervention, and when the effect is measured with a lag. Absorbing POKL funds in period t is associated with higher local revenues *per capita* in periods t and t + 1. The strongest positive effect of the intervention is observed in the regions experiencing the post-transformation structural problems, that is, in the regions belonging to the structurally burdened urban categories. In these regions a 10% increase of the assistance corresponds with 1–1.6 percentage points shift in future revenues. A smaller, but still significant effect (0.8–1 percentage points) is observed for municipalities within metropolitan, and traditionally urban regions.

While investment in human capital within the POKL programme seems to have some positive influence on the change in local revenues, it does not have a similar effect on people's mobility (see Figure 5). On the contrary, in nearly all types of regions, a sign of the allocation of POKL funds is negative, and the total effects are insignificant. The only exception is the lagged total effect for metropolitan regions, which is slightly above zero, but it remains insignificant. The largest negative coefficient is observed for the structurally burdened polycentric category. Here a 10% increase in the EU assistance is associated with a 0.025 a simultaneous drop in net migration per thousand population. This effect is though only significant at $\alpha = 0.1$.

Importantly, when looking separately at direct and indirect effects of human capital investment on migration between municipalities, we observe a relatively strong negative indirect impact in traditionally rural regions. The coefficient of -0.42 is much larger (in absolute terms) than any of the corresponding effects in other types of regions. It also offsets the positive direct effect of EU assistance on migration within the same specification (the latter is significant at $\alpha = 0.1$). It suggests that in rural regions investment in human capital has limited effectiveness as a measure against depopulation of peripheral localities, because the backwashing effect is likely to surpass the benefits from strengthening the local skills.

These results show that strengthening the local human capital potential does not necessarily mean preserving it for the locality, as the intervention may result in increasing the outflow of talented individuals (brain drain), and thus in petrifying the deprivation in less affluent areas of a region. They also suggest that the presence of a single, strong labour market pole may mitigate the brain drain phenomenon, as the negative effect is weaker in urban regions. It is also worth noticing that the total effects of cohesion policy on migration (if we just look at the coefficients and ignore that most of the effects are insignificant) is much lower in the longer term, than it is in simultaneous specifications.

5 | DISCUSSION AND AGENDA FOR FURTHER RESEARCH

The goal of this work was to examine the effects of EU cohesion-policy funded investment in human capital on the change in productivity and population level at the municipal level. Compared to previous studies we applied several novelties. We conducted our analysis at a low level of aggregation, using data on Polish municipalities. However, we took into account that the impact of different activities within cohesion policy may have a different territorial scope, and we controlled for the spatial correlation of the cohesion policy's effects between the neighbouring

I development by type of region. Results from the spatial autoregressive models with	
4 Direct, indirect and total effects of the cohesion policy project	sous and lagged independent variable
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INDEE 4 Direct, murect, simultaneous and lagged ind	ependent variable			מ מכיין מבינים אין	the of region. Key	מונא זו טווו נוופ אסמנו	lai autoregressive i	
Cohesion policy variable	Structurally burde	ned urban	Traditionally rural		Metropolitan		Structurally burde	ned polycentric
Dependent variable	Δ own revenues	net migration	Δ own revenues	net migration	Δ own revenues	net migration	Δ own revenues	net migration
	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
Direct	Simultaneous							
Revenues/population at t0	-1.073 (0.000)	-28.28 (0.000)	-1.271 (0.000)	-12.15 (0.000)	-1.199 (0.000)	-31.09 (0.000)	-1.872 (0.000)	-42.11 (0.000)
Cohesion policy variable	-0.012 (0.231)	-0.267 (0.091)	0.009 (0.435)	0.255 (0.072)	0.012 (0.126)	0.072 (0.563)	0.088 (0.000)	-0.101 (0.554)
Indirect								
Revenues/population at t0	-0.056 (0.863)	-15.41 (0.062)	0.411 (0.008)	-10.477 (0.097)	0.168 (0.387)	4.762 (0.338)	0.491 (0.128)	9.622 (0.299)
Cohesion policy variable	0.126 (0.000)	0.175 (0.219)	0.092 (0.000)	-0.419 (0.028)	0.080 (0.000)	-0.188 (0.140)	0.069 (0.000)	-0.146 (0.325)
Total								
Revenues/population at t0	-1.129 (0.001)	-43.69 (0.000)	-0.860 (0.000)	-22.62 (0.001)	-1.031 (0.000)	-26.33 (0.000)	-1.381 (0.000)	-32.48 (0.000)
Cohesion policy variable	0.113 (0.000)	-0.092 (0.386)	0.100 (0.000)	-0.164 (0.367)	0.092 (0.000)	-0.116 (0.305)	0.157 (0.000)	-0.247 (0.208)
Z	2052	2052	2,368	2,368	3,380	3,380	2,108	2,108
Pseudo_R ²	0.094	0.015	0.074	0.009	0.067	0.035	0.017	0.002
Direct	Lagged							
Revenues/population at t0	-1.269 (0.000)	-43.71 (0.000)	-1.470 (0.000)	-29.53 (0.000)	-1.457 (0.000)	-37.00 (0.000)	-1.594 (0.000)	-41.12 (0.000)
Cohesion policy variable	0.011 (0.343)	-0.025 (0.893)	0.029 (0.032)	-0.132 (0.415)	0.015 (0.085)	0.052 (0.701)	0.011 (0.359)	-0.226 (0.245)
Indirect								
Revenues/population at t0	-0.221 (0.624)	1.304 (0.961)	0.338 (0.174)	6.910 (0.568)	-0.030 (0.904)	5.325 (0.494)	0.242 (0.277)	8.986 (0.474)
Cohesion policy variable	0.092 (0.002)	-0.002 (0.992)	0.052 (0.001)	0.086 (0.682)	0.084 (0.000)	-0.044 (0.780)	0.112 (0.000)	0.015 (0.860)
Total								
Revenues/population at t0	-1.491 (0.001)	-42.41 (0.000)	-1.132 (0.000)	-22.62 (0.000)	-1.487 (0.000)	-31.68 (0.000)	-1.351 (0.000)	-32.13 (0.000)
Cohesion policy variable	0.103 (0.003)	-0.026 (0.397)	0.081 (0.000)	-0.045 (0.387)	0.100 (0.000)	0.007 (0.399)	0.123 (0.000)	-0.211 (0.276)
Z	1,539	1,539	1776	1776	2,535	2,535	1,581	1,581
Pseudo_R ²	0.119	0.012	0.087	0.015	0.064	0.041	0.088	0.006
	:							

Notes: p-values in parentheses. All specifications include fixed effects of municipalities and time.



FIGURE 4 Percentage-point change in local own revenues *per capita* (total effect over a 2-year period) in response to a 10% increase of POKL absorption at the municipal level, by type of region *Note*: * p < 0.1, ** p < 0.05, *** p < 0.01



FIGURE 5 Change in net migration per thousand inhabitants (total effect over a 2-year period) in response to a 10% increase of POKL absorption at the municipal level, by type of region *Note*: * p < 0.1, ** p < 0.05, *** p < 0.01

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municipalities. We compared the estimated impact of the two components within the programme in support of human capital (POKL), with the effects of other Polish programmes within the cohesion policy, using two different measures of potential outcomes. Finally, we were able to compare the effectiveness of investment in human capital between the four categories of Polish regions that differed in terms of socio-economic characteristics and the level of development.

We found evidence that POKL funds have a positive effect on local revenues, both simultaneously to the intervention, and when the impact is measured with a time lag. The effect of cohesion-policy projects within the other EU funded programmes (not related to human capital) is significantly smaller.

The stronger impact of human capital investments in comparison to other programmes corresponds to the findings of the European study by Rodriguez-Pose and Fratesi (2004) as well as the Portuguese and Spanish studies by Medeiros (2014, 2017). Moreover, the diminishing impact of the cohesion policy over time aligns with conclusions made by Rodriguez-Pose and Fratesi (2004), who found human capital investments effective in the short and medium term.

When comparing the immediate effects of the two parts of the POKL programme on local productivity, the impact of the regionally-administered part proved stronger than the centrally-allocated component. Although this may result from different characteristics of typical projects implemented within these two paths (see Appendix), it may also suggest that regional control over assistance programmes improves their effectiveness (in accordance with Szabo, 2016 and Bähr, 2008). However, the lagged effects of the two components are very similar in terms of magnitude.

The correlation of the EU assistance and the net migration to a municipality is negative in most specifications, but also statistically insignificant. Clearly, investing in human capital does not help to retain human resources on the local labour market. Human capital investments have been linked in the past with brain drain or brain waste effects (Herbst & Rok, 2013; Miyagiwa, 1991). Although we do not find direct evidence that cohesion policy may stimulate such processes for Polish municipalities, there is also no sign that EU funded investment in human capital may prevent depopulation of the least developed areas in the country. There is, however, a need for further research to obtain insight into the nature of the relationship between cohesion policy and migration.

The results from the "regionalized" models show that the influence of cohesion policy investment in human capital is diversified, subject to regional preconditions to economic development. This is in line with earlier findings of Fratesi (2020). In fact, several national programmes of regional development in European countries seem to be based on similar reasoning. For example, the Italian *Strategia per le Aree Interne* (Strategy for Internal Areas) is an attempt to limit the outmigration from the peripheral municipalities along with stimulation of the local economic development, acknowledging the territorial specificity (Barca et al., 2014; Lucatelli et al., 2018).

The effect of the POKL on local revenues turned out positive in all categories of regions, but it was strongest in the structurally burdened areas. The positive role of POKL was somewhat weaker in metropolitan and rural regions. This shows that investment in human capital may be helpful in addressing structural problems of regional economies. In line with earlier studies (Fiaschi et al., 2018; Mohl & Hagen, 2010), the less developed regions turn out to be the biggest beneficiaries of cohesion policy, but a within-region cohesion is difficult to achieve in a presence of a dominant territorial unit, potentially draining resources from the peripheral localities.

Further results confirm that attempts to strengthen local human capital should not be considered an effective way to preserve human capital potential within peripheral areas. In rural regions a positive direct influence of POKL funds on migration balance was offset by a negative effect of assistance allocated to the neighbouring municipalities. However, in most specifications the impact of EU funding on migration turned out insignificant (typically with a negative sign of the coefficient). These results correspond to the evidence from Italy, as summarized by Fratesi (2020), who argues, based on an extensive review of the literature, that intervention on human capital might be effective in the case of a fast-growing regional economy, but in the case of the struggling regions it might just increase out-migration.

As mentioned in the introductory part of this paper, there obviously are more factors determining the successful cohesion-policy investment in addition to the ones analysed in our work. They include the quality of interventions and the regional institutional context (Bradley, 2006). The differing performances between Polish regions that have been observed in this study may result from different strategies of the given programme's implementation. Clearly,



there is a need for further research to test for the relationship between the endogenous policies towards the allocation of POKL funds in particular regions and the impact of the programme on local economies. This would require careful, qualitative insight into the regionally defined goals and instruments within the implementation of cohesion policy—particularly in those regions in which a positive and significant effect of cohesion policy has been observed. This would allow us a better understanding of whether the differences in the effectiveness of external aid are more subject to endogenous characteristics of the beneficiary regions, or to policy instruments used within the cohesion policy programmes. Overall, the results suggest that directing public intervention toward strengthening the potential of human capital may result in raising the local level of revenues, but the effectiveness of such investment differs between regions. In turn, investing the EU assistance funds in human capital has no desirable effect on the migratory patterns. Endowing people with new skills and competencies may stimulate outmigration from the economically lagging municipalities, which may still be beneficial for the migrating individuals, but not necessarily desirable in terms of territorial cohesion. It thus confirms the concerns on strengthening brain drain and suggests the need for more complex strategies to attract and retain talents in a region, as expressed in the report of the EU's Commission for Social Policy, Education, Employment, Research and Culture (SEDEC) in the European Committee of Regions (Cavallini et al., 2018).

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ENDNOTES

- ¹ Excluding children below 12 years old, and participants of conferences and seminars.
- ² Specified in the form as the "contact address", and thus possibly indicating a workplace location rather than a home address for some of the institutional participants.
- ³ As in the first year of implementation very little funds were spent, we decided that the first period will cover three years.

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APPENDIX: THE POKL AS POLAND'S COHESION-POLICY INSTRUMENT TO INVEST IN HUMAN CAPITAL

The POKL is the largest, concluded operational programme funded by the ESF. The original allocation of 9.7 billion EUR was increased over the course of the programme to reach 10.0 billion EUR. Of the programme's total budget, 68% was allocated to the regional component governed by regional authorities, while the remaining 32% was managed by the central administration. The official goal of the programme was defined as enabling full utilization of the potential of human resources, by increasing employment and the adaptiveness of enterprises and their employees, improving the health status of employees, raising the level of society's education, reducing areas of social exclusion, and supporting the building of state administrative structures.

The programme was divided into 10 priority axes, with 4 of them comprising the regional component (see Table A1).

One of the key issues for regional policy-making is the spatial distribution of centrally-administered funds, including those within the cohesion policy. In order to achieve transparency and impartiality, the process of allocating regional shares is often governed by an unequivocal mathematical formula—an algorithm. The algorithm itself provides a framework for regional policies, but the resulting allocations depend also upon other factors, for example, the absorption potential of the given region. Exploring the spatial effects of cohesion policy, especially at the subnational level, requires taking a closer look at the algorithms used in the allocation process.

The spatial distribution mechanism of cohesion policy spans several tiers of public administration. It begins with the EU level, where the so-called Berlin methodology guides the allocation of funds between Member States on the basis of regionalized data on GDP, population, and unemployment levels (Bachtler et al., 2006). Next, Member States decide on the allocation of funds between regions. In the case of Poland there were two separate algorithms: (i) administering the distribution of ERDF funds for regional Ops; and (ii) the POKL algorithm, dedicated to the regional component of the ESF-funded OP (Malinowska -Misiąg et al., 2016). Finally, regional (NUTS-2) authorities may specify mechanisms influencing the local distribution of funds. In the case of the POKL there were no dedicated algorithms put in place at this level, but the territorial distribution of allocation has been shaped indirectly, specifying the particular selection criteria of projects. Thus, the key mechanism governing the regional distribution of POKL funds was the algorithm for the regional component allocation, as devised by the Ministry of Regional Development. It took the following shape:

$$\mathsf{ESF}_{\mathsf{W}} = 97\% * \mathsf{ESF}_{\mathsf{KR}} * \mathsf{A}_{\mathsf{W}} + \mathsf{ESF}_{3\%\mathsf{W}}$$
(A1)

where ESF_W – ESF funds allocated through the POKL regional component to a region "w," ESF_{KR} – total ESF funds allocated to the POKL regional component, $ESF_{3\%W}$ – 3% of the total ESF funds allocated to the POKL regional

TABLE A1 Allocation to priority axes and components within the POKL

	Total fund	ling	
Priority	[million €]	[% of allocation]	Component
I. Employment and social integration	372.0	3.7	Central
II. Development of human resources and adaptation potential of enterprises and improvement in the health condition of working people	622.5	6.2	Central
III. High quality of the education system	607.7	6.1	Central
IV. Tertiary education and science	844.3	8.4	Central
V. Good governance	375.0	3.7	Central
VI. The labour market open for all	2313.9	23.1	Regional
VII. Promoting of social integration	1392.6	13.9	Regional
VIII. Regional human resources for the economy	1391.9	13.9	Regional
IX. Development of education and competencies in the regions	1706.2	17.0	Regional
X. Technical assistance	381.2	3.8	Central
Total POKL	10007.4	100	-

Source: www.kapitalludzki.gov.pl.

component, devoted to the Eastern Poland macro-region, A_W - algorithm coefficient calculated for a region 'w' using the following formula:

$$A_{W} = (w_{I} * 0, 4) + (w_{p} * 0, 15) + (w_{b} * 0, 25) + (w_{r} * 0, 1) + (w_{GDP} * 0, 1),$$
(A2)

where w_l – population of a region 'w' as a share of total population in Poland, w_p – number of SMEs (enterprises between 10 and 249 employees) in a region 'w' as a share of total number of SMEs in Poland, w_b – people registered as unemployed in a region 'w' as a share of total number of people registered as unemployed in Poland, w_r – agriculture-dependence coefficient, described below, w_{GDP} – regional GDP coefficient, described below:

$$w_{\rm r} = \frac{\frac{R_{\rm W_{\rm w}}^2}{R_{\rm k} E_{\rm w}}}{\sum_{\rm r}^{\rm A_{\rm c}} \frac{R_{\rm w}^2}{R_{\rm k} E_{\rm w}},}$$
(A3)

Where R_w – number of people living off work in their own farm in a region "w", R_k – number of people living off work in their own farm in Poland, Z_w – arable land in a region 'w', in hundreds of hectares:

$$w_{PKB} = \frac{\frac{2L_w}{GDP_k}}{\sum_{R=1}^{16} \left(\frac{2L_w}{GDP_k} - \frac{GDP_w}{GDP_k}\right)},$$
(A4)

Where GDPw – GDP in a region "w", GDPk – GDP in Poland, Lw – population of a region "w", Lk – population of Poland.