Does Self-Employment Foster Regional Economic Performance? Evidence from Four Post-Socialist Countries[1]

Martin BOĎA – Mariana POVAŽANOVÁ** – Lenka ĎURČANSKÁ***

Abstract

For 37 regions of four Visegrád Group (V4) countries that used to be part of the Socialist Bloc, the paper studies the interaction between self-employment (as a proxy of entrepreneurial capital) and per-capita real gross domestic product (as a measure of economic performance or prosperity). A system of two simultaneous spatial panel data equations is applied to aggregate regional data for a period of 20 years from 2001 to 2020 in order to explore the links between entrepreneurial activity and performance and to identify determinants of this relationship. Mutual positive correlation is found between self-employment and regional economic performance, and a number of regional labor-market, demographic or socio-economic characteristics are identified to be factors of the entrepreneurship-development nexus. Only Hungarian regions deviate from this generally established pattern. The present study complements the research agenda that has been so far pursued exclusively for Western and developing countries.

Keywords: *self-employment, regional economic performance, V4 countries, simultaneous equations spatial regression*

JEL Classification: E24, R11, L26

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The data and R codes upon which this study draws are available from the corresponding author upon request.

Introduction

There are a number of ways by which entrepreneurs may be conducive to economic development. Seeking out actively new business opportunities, testing consumer tastes, enhancing competition, willing to work more eagerly and delivering higher productivity, entrepreneurs are frequently credited with technological innovations (van Stel et al., 2005, pp. 311 – 312; Thurik et al., 2008, p. 674). Their innovative capacity constitutes entrepreneurship capital that transposes knowledge to economically exploitable knowledge and contributes to knowledge spillovers that in turn accelerate economic growth (Audretsch and Keilbach, 2004). Albeit Braunerhjelm et al. (2010) or Acs and Sanders (2013) formalize this notion in a theoretical framework of economic growth, the empirical evidence is actually somewhat mixed. To a great extent, results vary with the type of entrepreneurship considered, the level of economic development of the country of question and even the spatial level of the analysis (Munyo and Veiga, 2022, p. 4). That said, the prevalent finding that springs out with some regularity in cross-country studies is a positive link between entrepreneurial activity and economic performance at an aggregate national level for developed or high-income countries, whilst this link for developing countries is either negative (e.g. van Stel et al., 2005; Doran et al., 2018; Almodóvar-González et al., 2020) or absent (Stam et al., 2013; Valliere and Peterson, 2009).[2] Newer studies establish a positive relationship even for developing countries for some kind of entrepreneurship (Munyo and Veiga, 2022). Understandably, academic interest in the entrepreneurship-growth or entrepreneurship-development nexus descends also to a regional or local level, but such enquiries are rather scarce as complain Tsvetkova et al. (2019). This kind of regional studies is common for developed countries such as the USA, Germany, Sweden or Spain (e.g. Tsvetkova et al., 2019; Carree and Thurik, pp. 578 – 580) or developing countries such as Indonesia (Nurmalia et al., 2020), and they mostly agree that entrepreneurs are positive agents of regional economic prosperity. In spite of this vast research exposure, post-Socialist countries are somewhat exempt from inquiries of the sort; be that on a national or regional level. Exceptions are perhaps Berkowitz and DeJong (2005) who studied aspects of entrepreneurship activity and economic growth in post-Soviet regions, Dvouletý (2017) who studied the entrepreneurship-development nexus for Czech regions, or international cross-sectional comparisons that marginally incorporate these countries (e.g. Liñán and Fernandez-Serrano, 2014).

[2] These studies follow after a cross-country comparison by Blanchflower (2000) who found evidence for neutral or even negative effects of entrepreneurship on economic growth for 23 OECD countries, but was later criticized by Carree and Thurik (2010, p. 581) for having used uncorrected data unsuitable for international comparison.

The question of whether entrepreneurship promotes economic development is not only relevant to growth theorists, but is also of interest to empiricists and policy-makers whose natural concern is to secure economic prosperity. Given the significance of entrepreneurial activity for an economy, practical policy-making needs a knowledge of why some areas are denser with entrepreneurial activity than others, or what factors encourage interest in entrepreneurship at the expense of waged or salaried employment or deflect an individual from unemployment. Another strand of literature, distinct from the one engaged with the entrepreneurship-development nexus, focuses on the patterns of entrepreneurial activity across regions and seeks factors that drive individuals to self-employment as an occupational choice. Some studies that compare the intensity of entrepreneurial activity and explain the observed variation by a set of potential determinants accomplish this exploration at a national level across a panel of countries (e.g. Parker and Robson, 2004; Amorós et al., 2016; Dheer, 2017), whilst others use regionally aggregated data (e.g. Benedict and Hakobyan, 2008; Burke et al., 2009; Hammond and Gurley-Calvez, 2014). Nonetheless, studies that use data on individual entrepreneurs in order to identify determinants of self-employment entry are much more proliferated (e.g. Dawson, 2014; Tamvada, 2015) to an extent that their findings deserved systematic literature surveys by Simoes et al. (2016) or Wan (2017). Again, former Socialist countries continue to be overlooked.[3]

Combining both research directions outlined before, the paper focuses upon four post-Socialist countries in Central Europe; to wit Czechia, Hungary, Poland and Slovakia. These four neighboring countries form a loose conglomerate grounded in cultural and political cooperation that is referred to as the Visegrád Group (or Visegrád Four, V4).[4] In spite of common cultural and historical commonalities and successful market transitions through the 1990s, their development trajectories towards entrepreneurial economies are qualitatively different, which makes them an interesting object of study (Cieślik and van Stel, 2014). For 37 statistical regions of V4 countries that arise from the NUTS 2021 classification in the second tier of division,[5] the paper investigates the form of the relationship that exists

[3] Albeit Dvouletý (2017) investigated for Czech regions on an aggregate level how newly established businesses and fresh self-employment interacted with regional economic performance, he did not extend his inquiries towards identification of factors behind the intensity of entrepreneurial activity.

[4] With a population of 63.7 million inhabitants and a gross domestic product (GDP) of 1.07 trillion EUR in 2021, the four V4 countries made 14.24% of the total population and 7.36% of the GDP of the European Union (European Union, 2022a).

[5] NUTS is an acronym formed of "Nomenclature of territorial units for statistics". The NUTS classification divides the economic territory of the European Union and the United Kingdom hierarchically into three tiers of territorial units that are used for statistical purposes and framing of cohesion policies. The current NUTS 2021 classification has been effective from 1 January 2021 and defines 92 NUTS 1 regions, 242 NUTS 2 regions and 1166 NUTS 3 regions (European Union, 2022b).

between regional entrepreneurial activity and economic prosperity, and considers several possible explanatory factors of the entrepreneurship-development nexus. Towards this end, regional data for the longest available period spanning two decades from 2001 to 2020 are employed in conjunction with a bivariate system of spatial panel data equations that account for the presumed endogeneity between the intensity of entrepreneurship and economic performance and encompass selected socio-demographic, labor market, structural and economic determinants. In this respect, entrepreneurial activity despite some ambiguity of definition is operationalized through self-employment, and self-employment rates are utilized as a viable method of measuring entrepreneurial capital. This choice translates immediately into the title of the paper. The framework adopted for the analysis permits answering two questions at a time: *Does self-employment foster regional economic performance? What factors stimulate or depress regional self-employment and regional economic performance?*

The paper makes several inputs to the entrepreneurship literature. First, it combines two research agendas in a statistically valid manner, and extends an exploration of the entrepreneurship-development nexus immediately towards its explanation. Second, these aspects are examined for regions of post-Socialist countries for which this kind of systematic research is actually absent.[6] Third, the examination is not undertaken in the spirit of individual occupational choice, but with aggregate data taking into account regional specifics. Thus, usefulness of the present findings is directly aligned with the informational needs of structural policies promoting economic growth in the economy and regions. Finally, spatial patterns are explicitly considered and integrated into the modelling framework whilst recognizing that regions in different countries are subject to limited or no economic spillovers.

The findings suggest that the relationship between self-employment and regional performance is not uniform across the V4 countries. Whereas in most regions ofV4 countries, the entrepreneurship-development nexus is found positive, in Hungarian regions this relationship is reverse and driven differently by an exposure to specific regional factors. The only consistent, and in this case negative, determinant of self-employment across the panel of V4 countries is taxation, which is a recurring finding in the literature.

The balance of the paper is organized into four other sections. After Section 1 has made methodological notes, Section 2 describes the data set and its construction, and Section 3 presents the results. The last section summarizes and concludes.

[6] This is not to say that the entrepreneurship literature did not study countries belonging in the past to the Soviet Bloc from other angles. For instance, at the turn of the millennium, the time was ripe to evaluate business support and self-employment inducing programmes implemented with transition towards a market economy in Central and Eastern Europe (Bateman, 2000).

1. Methodological Comments and Modeling Framework

It is well known that entrepreneurship is a multi-faceted notion that is very difficult or even impossible to summarize by one indicator (e.g. Audretsch and Keilbach, 2004, p. 612; Nurmalia et al., 2020, p. 30), and any metric is literally doomed to suffer from some neglects, inaccuracies or limited coverage in a cross-country context (e.g. Storey, 1991, p. 168; Braunerhjelm et al., 2010, pp. 114 – 115). Early studies relied on self-employment rates limited to non-agricultural sectors (e.g. Evans and Jovanovic, 1989; Evans and Leighton, 1989), which is a choice that exhibits considerable persistence to date (e.g. Blanchflower, 2000; Thurik et al., 2008; Tamvada, 2015; Tsvetkova et al., 2019). Instead of using self-employment rates, a different approach favors using business ownership rates (e.g. Carree et al., 2002; Albert, 2017; Nurmalia et al., 2020), or sometimes start-up rates are preferred to capture the formative or creative aspect of entrepreneurship (e.g. Audretsch and Keilbach, 2004).

Nonetheless, alternative measures are available that sprouted out of population and expert surveys undertaken under the project of the Global Entrepreneurship Monitor <https://www.gemconsortium.org>, such as diverse total early-stage entrepreneurship activity (TEA) indices. They have become increasingly used since they permit distinguishing opportunity and necessity entrepreneurs (e.g. van Stel, 2005; Stam et al., 2013; Munyo and Veiga, 2022). That said, different measures of entrepreneurial activity are typically not at variance (e.g. van Stel, 2015), and despite their different focus of measurement and informational power, there is some arbitrariness in their use. On the one hand, in their survey Carree and Thurik (2003, p. 565) reserve the synonymic manipulation with the terms business owners and the self-employed; on the other hand, they argue that business owners are only entrepreneurs in a formal sense only since they did not have to be true agents of innovative capacity.

Albeit this paper employs the total self-employment rate to operationalize entrepreneurship and to proxy its measurable aspects, this self-employment rate is defined relative to total labor force (in the age cohort 15 – 64 years) and is not restricted to non-agricultural activity.

As to whether non-agricultural activity should or should not be excluded is somewhat controversial in the literature (cf. Blanchflower, 2000, p. 479), but a self-employment rate derived from total labor force (i.e. # self-employed persons / total labor force) measures actually realized entrepreneurial potential against a basis that supplies persons for entrepreneurship. Since also unemployed persons may elect to become self-employed, total employment in the denominator would induce a bias.

Likewise, with some simplification it may be said that people outside labor force are unlikely to be viable candidates for self-employment, which argues against total population in the denominator.[7]

Finally, the V4 countries are all high-income economies with a reasonable share of agriculture on gross value added in individual regions (see Table 6 of Appendix A). Self-employment in agriculture is not a necessity, but has benefits of a structured autonomous choice.

A key ingredient of the modeling framework is the presumed endogeneity triangle between economic performance, self-employment and unemployment. Causal links between economic performance and self-employment are the cornerstone of the entrepreneurship-development nexus. Entrepreneurship is one of the engines of economic growth (e.g. Carree et al., 2002, p. 276; van Stel et al., 2005, pp. 311 – 312), whereas the prosperity-push hypothesis explains, partly through the reduction in the unemployment channel, that in times of economic booms entrepreneurship blooms (Parker, 2004, p. 95). The trade-off between self-employment and unemployment follows from the fact that an individual weighs relative benefits of employment, self-employment and unemployment and chooses one of these options for their occupation or withdrawal from activity in the labor market (Thurik et al., 2008, p. 674; Faria et al., 2010, p. 1283). The theory of prosperity-pull and recession-push factors justifies causal links in both directions (Thurik et al., 2008, p. 674; Benedict and Hakobyan, 2008, pp. 269 – 270).[8]

Finally, the mechanism operating between unemployment and economic performance follows, e.g., from Okun's law (Faria et al., 2010, p. 1282; Huang and Lin, 2006, p. 326) that completes the triangle.

The entrepreneurship-development nexus is captured and modeled by dint of two simultaneous equations explaining entrepreneurship (measured by the self-employment rate) and economic performance (measured by the logarithmized real

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[7] The segment of the population that is taken out of the labor force consists of long-term sick or disabled persons, individuals with permanent family and caregiving responsibilities, students, retired persons and discouraged workers. Yet, a typical composition of this economically inactive population is dominated by those who have little prospects to enter the labor force, and most economically inactive people in fact do not look for such opportunities, be it for employment or self-employment (e.g. Eurofound, 2024, pp. 14 – 15).

[8] Simply speaking, factors that stimulate economic agents to engage in entrepreneurial activity can either have an incentivization nature, and these pull individuals to entrepreneurship (so-called pull factors), or their nature may be coercive, and these push individuals to entrepreneurship (so-called push factors). A stylized example is the effect of the business cycle on entrepreneurship: in an upswing phase, individuals are drawn or pulled to business activity, whilst in a recessionary phase individuals are forced or pushed to entrepreneurship in order to escape unemployment. It is worthwhile noting that push and pull factors are not only related to business cycles.

A more complete enumeration would include taxation, government programs to stimulate business activity, relative earnings from paid employment and self-employment (e.g. Benedict and Hakobyan, 2008).

gross domestic product per capita). In addition to bivariate simultaneity, the modeling framework explicitly recognizes in the input data both spatial interactions and their panel structure. Both fixed and random effects are considered despite the fact that the philosophy of the model choice points to fixed effects as each region in the sample is likely to manifest constant individual characteristics that make it specific. The considered system of two simultaneous spatial error equations with fixed effects is an adaptation of the model proposed by Kelejian and Prucha (2004), and introduces spatial effects through the error mechanism. These effects are controlled by the spatial weights matrix **W** that encodes information on the adjacency of pairs of regions (Arbia 2014, chapter 2) and whose each row, say $\mathbf{w}_r$, describes spatial relations of region r to all R regions (for $r \in \{1, ..., R\}$). As detailed soon in Section 3, the spatial weights were set to exclude extranational neighborhoods. The model may be formally stated for region r and year t as

$$\begin{aligned} y_{1\,r,t} &= \alpha_{1\,r} + \boldsymbol{\beta}_1' \mathbf{y}_{r,t} + \boldsymbol{\delta}_1' \mathbf{x}_{1\,r,t} + u_{1\,r,t}, \quad u_{1\,r,t} = \rho_1 \mathbf{w}_r' \mathbf{u}_{1\,t} + \zeta_{1\,r,t} \\ y_{2\,r,t} &= \alpha_{2\,r} + \boldsymbol{\beta}_2' \mathbf{y}_{r,t} + \boldsymbol{\delta}_2' \mathbf{x}_{2\,r,t} + u_{2\,r,t}, \quad u_{2\,r,t} = \rho_2 \mathbf{w}_r' \mathbf{u}_{2\,t} + \zeta_{2\,r,t} \end{aligned} \tag{1}$$

where the role of subscripts r and t is obvious. Amongst the regressands, y_1 represents the self-employment rate, y_2 stands for the logged real gross domestic product per capita, and the vector of endogenous variables $\mathbf{y} = (y_1, y_2, y_3)'$ also contains the unemployment rate y_3, which is not explicitly modeled. In equation k (with $k \in \{1, 2\}$), the regressand y_k is modeled by other endogenous variables in **y** and exogenous variables $\boldsymbol{x}_k = (x_{k1}, x_{k2}, ..., x_{km(k)})'$. The composite error term u_k in equation k is governed by its separate spatial mechanism induced through the spatially lagged component $\mathbf{w}_r' \mathbf{u}_k$ and by the idiosyncratic error ζ_k. Here $\mathbf{u}_k$ is a vector of composite errors for all regions, hence, $\mathbf{u}_k = (u_{k1}, u_{k2}, ..., u_{kR})'$. The intensity of spatial effects is determined by the spatial lag constant ρ_k, which is a nuisance parameter satisfying $|\rho_k| < 1$. The parameters of interest are fixed effects α_1 and α_2, regression coefficients at endogenous variables $\boldsymbol{\beta}_1 = (0, \beta_{12}, \beta_{13})'$ and $\boldsymbol{\beta}_2 = (\beta_{21}, 0, \beta_{23})'$ as well as regression parameters at exogenous variables $\boldsymbol{\delta}_1$ and $\boldsymbol{\delta}_2$. The idiosyncratic error is assumed serially uncorrelated, homoskedastic with variance $\sigma^2_{\text{idiosyncratic}}$, and uncorrelated with exogenous variables. Whereas with fixed effects α_1 and α_2 are region-specific constants, with random effects, they are additively broken into an intercept μ and random region-specific additions γ_1 and γ_2 uncorrelated with the regressors and with variance $\sigma^2_{\text{individual}}$. In the statement of model (1), this means that α_1 and α_2 are replaced by $\mu + \gamma_1$ and $\mu + \gamma_2$, respectively. The estimation procedure first utilizes the generalized moments procedure of Kelejian and Prucha (1999) to estimate the spatial lag parameters ρ_1 and ρ_2, and then applies the feasible generalized spatial three stage least squares (FGS3SLS) estimator with full consideration of endogeneity via instrumental variables to obtain estimates of regression parameters.[9]

Whilst β_{12} and β_{21} measure how self-employment and economic performance exert their influence upon each other, and decide how the entrepreneurship-development nexus stands, $\boldsymbol{\delta}_1$ and $\boldsymbol{\delta}_2$ set the factors that determine either. The list of predictors was partly inspired by other entrepreneurship studies (Georgellis and Wall, 2000; Parker and Robson, 2004; Hammond and Gurley-Calvez, 2014; Nurmalia et al., 2020) or surveys of self-employment determinants (Simoes et al., 2016; Wan, 2017).

The list of exogenous predictors in the vectors $\mathbf{x}_1$ and $\mathbf{x}_2$ applied to *both* variables of interest, y_1 and y_2, includes long-term unemployment (as a proxy for the relative portion of the unemployed labor force with a high likelihood of disrupted working patterns), female share in the labor force (owing to the stylized gender differences in occupational preferences), population density (as a proxy of urbanization), tertiary educational attainment (as a proxy for human capital), shares of agriculture, industry and construction on production (as proxies for the sectoral structure of the regional economy), output gap (as a measure of business cycle fluctuations), recessionary spell duration (as a measure of the "recession-push" conditions).[10] In addition, self-employment represented by y_1 was also explained by older worker share in the labor force (to capture possible age effects on self-employment), employee protection (as a measure of relative suitability of waged or salaried employment) and relative taxation of self-employment income (as a measure of cross-country differences in the tax systems). Likewise, economic prosperity proxied by y_2 was explained by youth share in the labor force (to control for age effects on regional prosperity) and relative expenditure on research and development (to reflect the regional innovative capacity). Three instrumental variables were employed to address the endogeneity problem common to each equation, i.e. primary educational attainment, public sector employment rate, real gdp growth rate.

In a sense, the existence of the links articulated by the triangle between the three key variables has already been partly recognized in a context relevant to the present study. Specifically, Dvouletý (2017) posited for Czech regions equations

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[9] The analysis was entirely performed in the program R, and the codes in this respect were adapted from Gianfranco Piras and his semi-finished R package spse <https://rdrr.io/rforge/spse>.

[10] Out of these, agricultural share in regional output is applied in an effort to address the stylized fact that agricultural self-employment may constitute a substantial share on total self-employment for some countries, which motivates some researchers to exclude agricultural self-employment from considerations (Parker, 2004, pp. 8 – 11; Parker and Robson, 2004, p. 290). Apparently this does not generalize easily since Slovakia displays very low levels of self-employment in agriculture as a historical consequence of Socialist policies (OECD/European Commission, 2021, p. 83), which contrasts with Poland whose self-employment rates are large by all standards (Hattfield, 2015, p. 36).

for economic performance and unemployment with recursive relationships and new self-employment or business activity as one of additional predictors. Yet, these equations were not estimated as a simultaneous system and no consideration was given to possible endogeneity.

Ultimately, the present static framework may not be fully ideal in the light of empirical evidence that the impact of entrepreneurship on regional development may be a medium-term process whose effects may vary over a span of several years (Fritsch and Mueller, 2004), which justifies the use of vector autoregressive approaches (e.g. Thurik et al., 2008). Nonetheless, the adopted model does not intend to explain changes in the intensity of entrepreneurial activity through new business formation or changes in self-employment rates, in consequence of which is formulated as static.

2. Data Description

The analysis was conducted for the 37 regions of the four V4 countries that fall into the second tier of division as defined in the NUTS 2021 classification being in force at the time of the analysis (European Union, 2022b). The current classification encompasses 8 regions for Czechia (CZ), 8 regions for Hungary (HU), 17 regions for Poland (PL) and 4 regions for Slovakia (SK). Their enumeration and codes are provided in Table 4 in Appendix A. Regions are labeled with codes consisting of two letters and two figures. The letters are alpha-2 country codes compliant with the ISO 3166 international standard, and are extended by two figures to label particular regions.

The data for the analysis were downloaded from publicly available sources provided by official authorities (the Eurostat database, reports of the European Commission, the OECD.Stat database) for the longest available period, which limited the analysis to two decades running from 2001 to 2020 and an annual frequency of observations. Most variables listed in Table 5 of Appendix A appertain to region-specific conditions except four variables that capture general economy-wide conditions, eprot, gdpgap_ec, gdprec_ec and taxself. Likewise, most variables were readily available without a need of specific computation save the two variables related to business cycle fluctuations, gdpgap_ec and gdprec_ec. These two variables were computed *ad hoc* by using standard definitional formulas from economy-wide data. The details on the computation are declared in the notes to Table 5. At any rate, the key variables for the analysis are rgdp_pc (real gross domestic product per capita) that acts as a relative measure of regional prosperity or regional production (United Nations et al., 2008, paras. 19.15, 19.74), and selfer (self-employment rate) that constitutes a handy proxy of realized entrepreneurship capital. The table lists three variables with an endogenous status (rgdp_pc, selfer, ur), and three exogenous instruments (school1, publer, rgdp_dif), whereas other variables fulfill the role of exogenous regressors. In order to make a balanced panel and maximize the availability of data, absent observations for some variables at the beginning or the end of the sample for some regions were imputed by procedures similar to Maza (2022).

Basic descriptive statistics for the resulting panel of 740 observations (for 37 regions over 20 years) are reported in Table 6 of Appendix A separately for each of the V4 countries. The tabular output of Table 6 evinces notable cross-country as well as within-country regional heterogeneity manifested virtually by each variable. Perhaps Czech and Slovak regions are more comparable in terms or regional prosperity (rgdp_pc), and so are Hungarian and Polish regions between themselves. That said, more cross-country diversity is displayed in self-employment rates (selfer). Czech and Hungarian regions are comparatively more populated per area than Polish and Slovak regions (popdens) or recorded comparatively slower regional growth rates over the two decades under scrutiny (rgdp_dif), but all regions are fairly similar in terms of the share of females and older workers in the labor force (lfsh_f, lfsh_4564). The latter does not relate to the share of young workers in the labor force since youth labor supply is higher in Polish and Slovak regions (lfsh_1524). Research and development activity receives less funding in Polish and Slovak regions than in Czech and Hungarian regions (rde_perc), and regional public employment in each country typically takes more than a 20% share of total employment (publer). It is also worth noting that Poland shows high tertiary education attainment rates in its regions (school3), a high level of relative taxation of income from self-employment (taxself) as well as a greater exposure to business cycles (gdpgap_ec). Slovakia is characteristic of the comparatively highest levels of unemployment (ur) and long-term unemployment (lt_ur). Likewise, Hungarian regions have the highest shares of a population with primary education only.

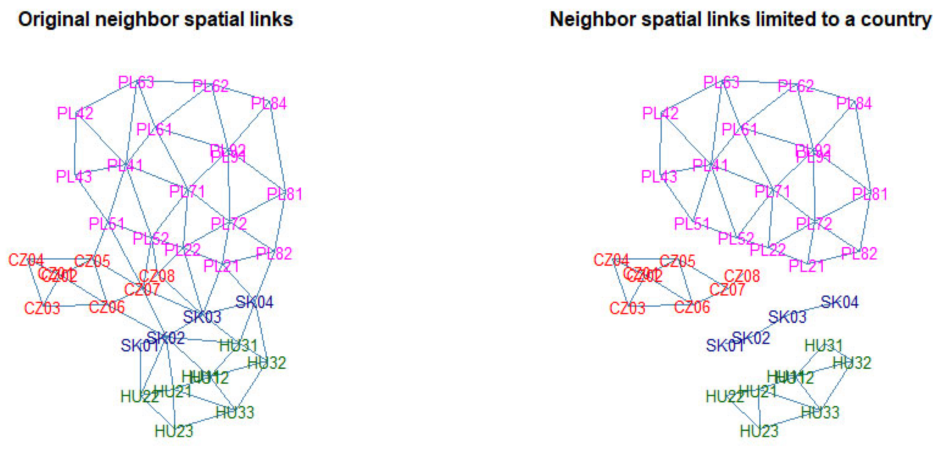
In step with convention, rgdp_pc enters the analysis after a logarithmic transformation, i.e. as log(rgdp_pc). Most of the variables that are used as regressands, regressors or instruments are unlikely to display trending patterns or non-stationary behavior except the key variables, log(rgdp_pc) and selfer. Yet, upon formal testing by a variety of panel data unit root tests (Maddala-Wu test, Im-Pesaran-Shin test, three variations of Choi's test), the results were convincingly significant with almost zero p-values suggesting thus stationary trajectories.

Finally, as announced in the preceding section, the definition of weights in consideration of spatial spillovers was guided by an effort to limit or exclude extranational effects and to allow only intranational links between regions. Towards this end, the traditional spatial weight matrix with contiguity-based entries with a value of 1 for adjacent regions and a value of 0 for a region without common borders was modified by resetting the entries for adjacent regions from different countries to 0. Certainly, there are bound to be some spatial interactions between neighboring regions of different countries, and a value somewhat greater than 0, such as 0.15 or 0.20, would be more apt, but this value would have to be introduced also for regions of the neighboring non-V4 countries. For instance, whereas there may slight interactions between Polish and Czech regions, these must also be present for Polish and German regions. Likewise, interactions between Slovak and Czech regions cannot be rightfully represented without considering interactions between Slovak and Austrian regions. These interactions are not considered, and to avoid an immeasurable bias, the extranational contiguity is suppressed. Nevertheless, the actually used spatial weight matrix **W** is further row-standardized in addition to the described adjustments.

Figure 1 juxtaposes the spatial links for all possible contiguity relations between the 37 regions of V4 countries against the spatial links that remain after deleting extranational relations. Whereas before the modification there were 166 pair-wise spatial links in total, the operation resulted in 124 links. The present approach to isolation of spatial links between regions only to intranational links is also supported by the sizeable differences with which the V4 countries managed their market transition and converged towards entrepreneurial economies (Cieślik and van Stel, 2014).

F i g u r e 1

Conventional and Actually Used Neighbor Spatial Links



Source: The authors.

3. Results

Before estimating bivariate spatial panel data regressions, as part of a preliminary exploration, the local level of economic prosperity (as measured by log(rgdp_pc)) was confronted with the self-employment rate (selfer) in each region separately. Figure 2 exhibits four scatter charts that are drawn each for one V4 country. Each scatter chart plots local economic performance (on the vertical axis) against local self-employment (on the horizontal axis) for all regions of the given V4 country. The entrepreneurship-development nexus is portrayed for each region by a line segment that answers to a simple regression equation fitted by least squares to the respective data, but that is drawn only on the range of self-employment rates observed for the region (on the horizontal axis). Not only does the portrayal of line segments in Figure 2 facilitate immediate comparison of the direction and strength of the examined association across regions, but it also gives a straightforward assessment to what extent individual regions vary by their level of self-employment or economic performance. For instance, the line segment located in each scatter chart in the uppermost position is drawn for the NUTS 2 region around the capital city (CZ01 for Czechia, HU11 for Hungary, PL91 for Poland, and SK01 for Slovakia).

Specifically, a simple linear equation was estimated by least squares for a particular region r and a specific year t in the form

$$\log(\text{rgdp\_pc}_{\text{r,t}}) = \alpha^{\text{r}} + \beta^{\text{r}}\cdot\text{selfer}_{\text{r},t} + \zeta_{\text{r},t}, \qquad (2)$$

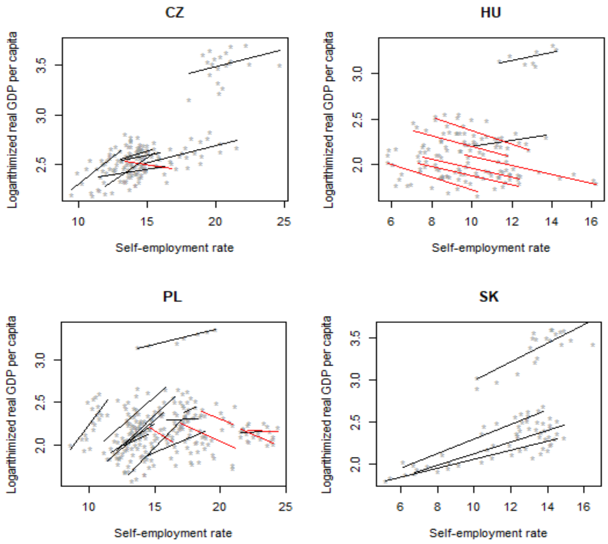
where α^{r} and β^{r} are the region-specific intercept and slope, respectively, and where $\zeta_{\text{r},t}$ is a random term (possibly fully compliant with the white noise assumption). For each of the 37 regions, equation (2) was estimated with the use of all 20 annual observations.

Nonetheless, the portrayal of Figure 2 is deceiving to an extent that not all slope coefficients (β^{r}) were actually statistically significant. The said neglect is remedied by presenting Table 1 that makes a full report of the estimated slope coefficients, their significances and corresponding R square measures for all the 37 regions. Whereas in most regions, self-employment and regional performance are positively related (or the relationship is insignificant), in the majority of Hungarian regions this relationship is negative. It is also somewhat untoward that the nexus is insignificant for the Prague CZ01 region and for the Budapest HU11 region as these are areas around the capital cities of Czechia and Hungary, respectively.

On the one hand, this analysis is fairly simplistic for two reasons at least. First, it ignores spatial dependence or any contemporaneous correlation between regions. Second, it only provides gross measures of the entrepreneurship-development nexus since it skips any factors that may affect the correlation.

F i g u r e 2

(Logarithmized) Real GDP per capita versus Self-Employment in Individual Regions



Note: Line segments shown in individual graphs answer to straight lines fitted that depict association between (logarithmized) real GDP per capita and self-employment by least squares for individual regions.

Source: The authors.

Ta b l e 1

Regressions of (logarithmized) Real GDP per capita on Self-Employment in Individual Regions

Region	Slope	R^2	Region	Slope	R^2	Region	Slope	R^2
	Czechia		**HU23**	**–0.050*****	**0.489**	**PL63**	**0.142*****	**0.814**
CZ01	0.035	0.107	**HU31**	**–0.068****	**0.397**	PL71	0.063	0.064
CZ02	**0.035***	**0.280**	**HU32**	**–0.050*****	**0.592**	PL72	0.009	0.007
CZ03	0.020	0.039	**HU33**	**–0.049*****	**0.587**	**PL81**	**–0.068***	**0.832**
CZ04	0.020	0.135		*Poland*		**PL82**	**–0.093****	**0.601**
CZ05	–0.022	0.027	PL21	–0.071	0.137	PL84	–0.004	0.002
CZ06	0.040	0.032	**PL22**	**0.199****	**0.390**	**PL91**	**0.038*****	**0.947**
CZ07	**0.094****	**0.372**	PL41	0.005	0.000	PL92	–0.065$^{\bullet}$	0.502
CZ08	**0.110*****	**0.601**	**PL42**	**0.130*****	**0.753**		*Slovakia*	
	Hungary		**PL43**	**0.101***	**0.253**	**SK01**	**0.112*****	**0.648**
HU11	0.046	0.279	**PL51**	**0.131***	**0.235**	**SK02**	**0.086*****	**0.840**
HU12	0.034	0.376	PL52	0.066	0.026	**SK03**	**0.069*****	**0.797**
HU21	**–0.058****	**0.386**	PL61	0.064	0.115	**SK04**	**0.054*****	**0.810**
HU22	**–0.073*****	**0.505**	**PL62**	**0.155*****	**0.617**			

Note: Regions with slopes significant at a 0.05 level are highlighted by boldface font. Significance labels displayed at computed regression coefficients convey the conventional meaning: *** for p-values ≤ 0.001, ** for p-values ≤ 0.01, * for p-values ≤ 0.05, and $^{\bullet}$ for p-values ≤ 0.10.

Source: The authors.

On the other hand, the visualization of Figure 2 and the report in Table 1 both warn that the entrepreneurship-development nexus may not be uniform and alike across the V4 countries. As a matter of fact, Hungarian regions should be perhaps treated separately, and the estimation of the spatial system (1) is thus accomplished for three variants of the sample; to wit, for the full sample (740 observations, 37 regions), for a subsample with Hungarian regions excluded (580 observations, 29 regions), and for a subsample of Hungarian regions only (160 observations, 8 regions).

A consistent finding for the period in question, from 2001 through 2020, communicated by Tables 2 and 3 is that in the 29 Czech, Polish and Slovak regions self-employment and regional prosperity are positively correlated and that the entrepreneurship-development nexus in a positive sense holds. Hence, on average economic prosperity in these regions boosts self-employment, and self-employment proves to be a factor of regional prosperity. Nonetheless, this fails to hold for the eight Hungarian regions where the relationship is reverse and self-employment and regional economic performance are negatively related. Furthermore, in Czechia, Poland, Slovakia as well as Hungary, regional unemployment is negatively correlated with self-employment and economic prosperity. Whilst the latter is an unsurprising manifestation of Okun's law (Blinder, 1997, p. 241), the former is in line with the view espoused by Knight (1921) that an individual chooses between unemployment, self-employment and employment relative to their marginal benefits. Hence, in regions higher unemployment is linked with lower self-employment, and the population is drawn away from entrepreneurial ventures.

The distinct correlational patterns concerning the variables in the endogeneity triangle detected for Hungary and the other three V4 countries can be further traced to the notions of necessity and opportunity entrepreneurs that are discussed in entrepreneurship literature (e.g. Liñán and Fernandez-Serrano, 2014; Porras-Arena and Martín-Román, 2019). Whereas for Czechia, Poland and Slovakia pull-factors seem dominant and individuals become self-employed primarily to avail themselves of opportunities, in Hungary, there are indications that self-employment is driven by both opportunistic prospects and necessity reasons. Interestingly, Porras-Arena and Martín-Román (2019) discovered that self-employment may have a mitigating effect upon Okun's law that introduces elasticity between unemployment and economic growth, operating under the proviso that self-employment is exogenous. This is only discernible for non-Hungarian V4 regions where the coefficient at the unemployment rate [ur] in the economic prosperity equation [log(rgdp_pc)] is smaller in absolute value. For Hungarian regions, in this sense self-employment exerts adverse effects.

A number of other regularities are manifested therewith. Across the V4 countries, taxation of self-employment income is a universal deterrent to self-employment, which is a finding that surfaces also in other studies (e.g. Parker and Robson, 2004; Benedict and Hakobyan, 2008). Tertiary education has diverse effects, which are positive upon regional prosperity across the V4 countries, but negative upon self-employment in Czech, Polish and Slovak regions. In these three V4 countries perhaps workers with tertiary education favor waged or salaried employment at the expense of self-employment. This may be just associated with the fact that individuals without higher education are forced into self-employment since they are likely to face difficulties in findings jobs that require greater expertise and schooling. In addition, for Hungarian regions, long-term unemployment the share of labor force in the age bracket 45 – 64 years are found to be factors detrimental to self-employment. These factors may for Hungary identify regions with a specific economic or demographic conditions associated with a lessened interest in self-employment. Whereas regional economic prosperity is found positively related to the economy-wide business cycle in each V4 country, self-employment in Czech, Polish and Slovak regions is lower with positive fluctuations in national economic activity. The former implies that whenever an economy operates above potential, this also stimulates economic prosperity in regions. That said, the presence of recessionary periods (or their durations) was not found to be a relevant factor as it explains consistently neither self-employment nor regional prosperity.

The results are somewhat mixed or inconclusive for female participation in the labor force, population density, regional sectoral shares of agriculture and construction, and employee protection in terms of effects exerted both on self-employment and economic performance. This happens for three reasons: owing to the absence of universal patterns of significance and signs of the estimated parameters, or because there is some discrepancy between the patterns that emerge for non-Hungarian regions and those for Hungarian regions, or because there is a glaring discrepancy between the estimates obtained with fixed and random effects.

Finally, Figure 3 displays the spatial distribution of self-employment and economic performance that remain unexplained by the factors under consideration and that passed into fixed region-specific effects. In order to assure comparability, the two choropleth maps are drawn for the fixed effects estimated with the full sample of 740 observations. The displayed effects may be construed as *ceteris paribus* propensities in individual regions to self-employment and some level of economic prosperity once other factors have been controlled for. As also noted earlier, the region-specific effects explain a considerable share of the original variability of self-employment rates and logarithmized real GDP per capita. Specifically, the correlation between self-employment rates and the corresponding fixed effects is 0.766, and that for logarithmized real GDP per capita is 0.606.

What is apparent in Figure 3 is that self-employment rates are comparatively highest, net of the factors considered, in typical Polish regions and lowest in typical Slovak regions. The spatial patterns of region-specific effects for regional performance differ in that that they point to systematic higher performance of Czech and Slovak regions.

T a b l e 2

Fitted Fixed Effects Models

	Full sample$^{†)}$ **(740 observations)**		**Hungarian regions excluded**$^{†)}$ **(580 observations)**		**Only Hungarian regions**$^{†)}$ **(160 observations)**	
Equation	**selfer**	**log(rgdp_pc)**	**selfer**	**log(rgdp_pc)**	**selfer**	**log(rgdp_pc)**
log(rgdp_pc)	**4.593*****		**8.763*****		**–8.323*****	
	(1.072)		(1.240)		(1.917)	
selfer		**0.008****		**0.022*****		**–0.029*****
		(0.003)		(0.003)		(0.000)
ur	**–0.134*****	**–0.011*****	**–0.017****	**–0.011*****	**–0.389*****	**–0.021*****
	(0.019)	(0.001)	(0.006)	(0.001)	(0.043)	(0.000)
lt_ur	0.006	0.000	0.006	0.001	**–0.056*****	**–0.002***
	(0.006)	(0.000)	(0.004)	(0.000)	(0.012)	(0.000)
lfsh_f	0.017	–0.006	0.148	–0.009$^{\bullet}$	**–0.420****	–0.015
	(0.314)	(0.004)	(0.094)	(0.005)	(0.130)	(0.000)
lfsh_1524		**–0.014*****		**–0.013*****		–0.010$^{\bullet}$
		(0.003)		(0.003)		(0.000)
lfsh_4564	**–0.149*****		–0.009		**–0.143*****	
	(0.030)		(0.070)		(0.031)	
popdens	**–0.004***	**0.000****	0.002	0.000	**–0.007*****	0.000
	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)
school3	**–0.111*****	**0.008*****	**–0.186*****	**0.010*****	0.083	**0.009****
	(0.020)	(0.002)	(0.033)	(0.002)	(0.129)	(0.000)
rde_perc		**0.084*****		**0.068*****		0.036$^{\bullet}$
		(0.010)		(0.010)		(0.001)
gvash _agr	**–0.183***	**–0.014****	–0.043$^{\bullet}$	**–0.023*****	–0.055	–0.005
	(0.071)	(0.004)	(0.025)	(0.005)	(1.005)	(0.000)
gvash _ind	**–0.158*****	**0.007*****	**–0.091****	0.003	**–0.081*****	**0.007*****
	(0.027)	(0.002)	(0.029)	(0.002)	(0.001)	(0.002)
gvash _cons	–0.003	**0.012****	0.028	**0.010****	**–0.206***	–0.004
	(0.013)	(0.004)	(0.027)	(0.003)	(0.018)	(0.002)
eprot	–0.678		–1.163$^{\bullet}$		2.102	
	(0.734)		(0.637)		(1.315)	
gdpgap_ec	–0.030	**0.003****	**–0.046***	**0.003*****	**0.090***	**0.007***
	(0.021)	(0.001)	(0.022)	(0.001)	(0.016)	(0.000)
gdprec_ec	–0.235	–0.002	–0.366	0.010	0.430	**0.053***
	(0.228)	(0.008)	(0.251)	(0.019)	(0.329)	(0.001)
taxself	**–16.304*****		**–12.896*****		**–36.717*****	
	(1.015)		(0.911)		(3.000)	
constant						
	Error components					
ρ	0.405	0.476	0.382	0.332	0.190	0.484
$\sigma^2_{idiosyncratic}$	1.031	0.003	0.941	0.003	0.338	0.002
	Goodness-of-fit measures$^{‡)}$					
Residuals	Gross	Conditional	Gross	Conditional	Gross	Conditional
$R^2_{(selfer)}$	–1.047	0.937	–1.698	0.936	–21.085	0.919
$R^2_{(log(rgdp\_pc))}$	0.670	0.976	0.554	0.981	0.097	0.984
$R^2_{(system, J)}$	–0.790	0.993	0.761	0.994	–28.996	0.994
$R^2_{(system, McE)}$	–44.737	0.997	0.943	0.998	–432.018	0.999
$R^2_{(system, D)}$	–0.288	0.954	–0.669	0.957	–11.130	0.950

Notes: $^{†)}$ In each case, the Hausman statistics with 27 degrees of freedom has an almost zero p-value, which points to the preferability of fixed effects over random effects. $^{‡)}$ All goodness-of-fit measures were computed from the (final) FGS3SLS residuals. Gross residuals are exclusive of fixed or random effects, whereas conditional residuals reflect contributions of fixed or random effects as appropriate. Three variations of the system R-square metric are reported: Judge et al. (1985, p. 477), McElroy (1977), and Dhrymes (1974, p. 245). They are labeled as "J", "McE", and "D", respectively.

Figures in parentheses are standard errors. Coefficients significant at a 0.05 level are highlighted by boldface font. Significance labels displayed at computed regression coefficients convey the conventional meaning: *** for p-values ≤ 0.001, ** for p-values ≤ 0.01, * for p-values ≤ 0.05, and $^{\bullet}$ for p-values ≤ 0.10.

Source: The authors.

T a b l e 3
Fitted Random Effects Models

	Full sample[†)] **(740 observations)**		**Hungarian regions excluded**[†)] **(580 observations)**		**Only Hungarian regions**[†)] **(160 observations)**	
Equation	**selfer**	**log(rgdp_pc)**	**selfer**	**log(rgdp_pc)**	**selfer**	**log(rgdp_pc)**
log(rgdp_pc)	**5.239***		**9.446*****		**–5.826*****	
	(2.311)		(2.737)		(0.458)	
selfer		**0.013***		**0.032*****		**–0.006*****
		(0.006)		(0.005)		(0.000)
ur	**–0.094*****	**–0.011*****	**–0.024*****	**–0.012*****	**–0.403*****	**–0.031*****
	(0.015)	(0.001)	(0.006)	(0.004)	(0.065)	(0.006)
lt_ur	–0.011	0.000	–0.010	**0.001****	**–0.040*****	0.000
	(0.013)	(0.000)	(0.031)	(0.000)	(0.009)	(0.000)
lfsh_f	–0.067	0.001	0.030	0.001	–0.090	–0.013$^{\bullet}$
	(0.091)	(0.008)	(0.044)	(0.001)	(0.105)	(0.007)
lfsh_1524		**–0.008*****		**–0.008*****		–0.001
		(0.002)		(0.000)		(0.000)
lfsh_4564	**–0.148*****		–0.037		**–0.097****	
	(0.028)		(0.031)		(0.032)	
popdens	**–0.001****	**0.000*****	–0.002	**0.000*****	**0.002*****	**0.000*****
	(0.001)	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)
school3	**–0.167*****	**0.012*****	**–0.220*****	**0.012*****	–0.012	**0.032*****
	(0.045)	(0.001)	(0.038)	(0.000)	(0.026)	(0.002)
rde_perc		**0.075*****		**0.058*****		–0.025
		(0.009)		(0.002)		(0.026)
gvash _agr	–0.022$^{\bullet}$	**–0.027*****	0.441	**–0.044*****	–0.023	**0.018*****
	(0.012)	(0.003)	(0.327)	(0.001)	(0.041)	(0.003)
gvash _ind	**–0.157*****	0.003$^{\bullet}$	**–0.108*****	0.002	**–0.032***	**0.016*****
	(0.019)	(0.002)	(0.021)	(0.000)	(0.016)	(0.001)
gvash _cons	**0.206****	0.003	0.141$^{\bullet}$	–0.006	0.020	**0.039*****
	(0.063)	(0.003)	(0.078)	(0.001)	(0.062)	(0.007)
eprot	**–3.262*****		**–3.986*****		**3.469***	
	(0.833)		(0.455)		(1.403)	
gdpgap_ec	–0.039	**0.004****	**–0.064***	**0.004*****	**0.077***	**0.006*****
	(0.026)	(0.001)	(0.027)	(0.000)	(0.031)	(0.002)
gdprec_ec	0.386	–0.007	–0.129	0.010	**0.618***	**0.095*****
	(0.314)	(0.125)	(0.436)	(0.002)	(0.315)	(0.015)
taxself	**–10.872*****		**–8.202*****		**–42.526*****	
	(0.779)		(0.597)		(2.495)	
constant	**30.418*****	**1.901*****	**12.402*****	**1.777*****	**33.652*****	1.636
	(3.491)	(0.160)	(1.586)	(0.034)	(4.072)	(1.169)
	Error components					
ρ	0.389	0.470	0.364	0.311	0.190	0.470
$\sigma^2_{idiosyncratic}$	1.013	0.003	0.944	0.003	0.338	0.003
$\sigma^2_{individual}$	1.218	0.004	1.296	0.003	0.000	0.004
	Goodness-of-fit measures[‡)]					
Residuals	Gross	Conditional	Gross	Conditional	Gross	Conditional
$R^2_{(selfer)}$	–0.357	0.920	–0.263	0.920	0.900	0.901
$R^2_{(log(rgdp\_pc))}$	0.712	0.974	0.620	0.976	0.952	0.952
$R^2_{(system, J)}$	0.839	0.990	0.888	0.993	0.993	0.993
$R^2_{(system, McE)}$	0.943	0.996	0.990	0.999	0.983	0.983
$R^2_{(system, D)}$	0.115	0.944	0.140	0.946	0.924	0.925

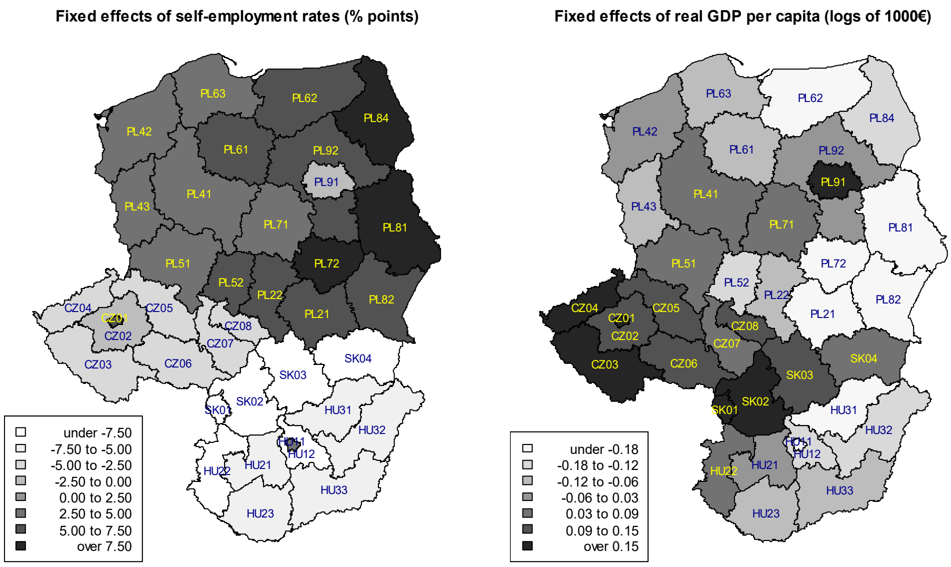
Notes: [†)] In each case, the Hausman statistics with 27 degrees of freedom has an almost zero p-value, which points to the preferability of fixed effects over random effects. [‡)] All goodness-of-fit measures were computed from the (final) FGS3SLS residuals. Gross residuals are exclusive of fixed or random effects, whereas conditional residuals reflect contributions of fixed or random effects as appropriate. Three variations of the system R-square metric are reported: Judge et al. (1985, p. 477), McElroy (1977), and Dhrymes (1974, p. 245). They are labeled as "J", "McE", and "D", respectively.

Figures in parentheses are standard errors. Coefficients significant at a 0.05 level are highlighted by boldface font. Significance labels displayed at computed regression coefficients convey the conventional meaning: *** for p-values ≤ 0.001, ** for p-values ≤ 0.01, * for p-values ≤ 0.05, and $^{\bullet}$ for p-values ≤ 0.10.

Source: The authors.

F i g u r e 3

Regional Dispersion of Self-Employment and Economic Prosperity: Fixed Effects



Source: The authors.

Final Notes and Conclusion

For a period of two recent decades from 2001 until 2021, the paper has studied the entrepreneurship-development nexus in 37 administrative regions of four V4 countries, verifying its validity and seeking its determinants. The V4 countries are all former Socialist countries where for a few decades before 1989 entrepreneurship in the meaning perceived in the entrepreneurship literature long did not exist, and isolated entrepreneurial activity (especially in Hungary) was neither able to contribute to creation of a competitive environment nor capable of introducing innovative ideas. Throughout the 1990s, they underwent a full transformation process towards a market economy, and the turn of the new millennium saw a new generation of enterprises operating in stabilized economic conditions. A natural question arises whether with the specific legacy of a Socialistic history the links between entrepreneurial activity and economic growth in these countries are positive (as is typical of developed Western economies) or more nuanced (as is common for developing countries). To the best knowledge of the authors, this research line has not been pursued as of yet. The inquiry into the direction of the entrepreneurship-development nexus and its determinants is handled in a simultaneous framework with a full consideration to possible spatial effects between regions. To this end, a modified spatial weights matrix with contiguity neighborhood and exclusion of extranational links is used with a system of two simultaneous panel data spatial error model equations.

Entrepreneurship activity is proxied by the self-employment rate, which is a conventional choice entertained in a number of entrepreneurship studies. Of course, this metric does not capture new business formation or any sort of changes in the intensity of entrepreneurial activity and differs from the business ownership rate (Light and Munk, 2018). It is merely a convenient proxy of accumulated entrepreneurial capital, and includes only small economic units, excluding thus corporations or large enterprises.

The results indicate that the patterns of the entrepreneurship-development nexus are not entirely homogeneous for the V4 countries. On the contrary, only for Czechia, Poland and Slovakia, the nexus is positive and beneficial causal links run in both directions. Self-employment in a typical Czech, Polish and Slovak regions boosts regional performance, and in a more prosperous region *ceteris paribus* self-employment is higher. Nonetheless, for Hungarian regions the nexus is negative, and self-employment is found negatively correlated with regional performance. With a negative correlation of unemployment with self-employment and regional performance in each V4 country, for Czechia, Poland and Slovakia this may suggest that entrepreneurship may mostly be driven by opportunity, whereas in Hungary entrepreneurship is a mixture of opportunity and neccessity choices, which may be related to the fact that Hungary is characteristic of less favorable conditions for entrepreneurship (OECD/European Commission 2021, p. 295). That said, this interpretation is to some degree conjectural since the analysis explicitly considered neither necessity and opportunity entrepreneurship nor nascent entrepreneurs as is in other studies (Liñán and Fernandez-Serrano, 2014; Munyo and Veiga, 2022). However, for a regional level or even for such a long span, in the case of the V4 countries more detailed data are unavailable.

Most explanatory factors that are found significant in the fitted regressions have effects differentiated for non-Hungarian and Hungarian regions. The only consistent factors that are all detrimental to regional self-employment are unemployment (though being endogenous), share of industry on total regional production, and taxation of self-employment income. Furthermore, region-specific individual characteristics play a substantial role in explaining the spatial distribution of self-employment rates. In Polish regions there is comparatively a higher level of propensity to become self-employed *ceteris paribus* than in other V4 regions.

The present analysis is undertaken with aggregate data for regions, and not with microdata collected by a survey on individuals. Therefore, the results do not explain why individual choose self-employment over unemployment, or waged or salaried employment, but uncover why in some regions self-employment rates are higher or lower than in others. The findings are relevant for governmental structural policies that might be interested to improve regional prosperity by stimulating entrepreneurial activity. First, there are some regions with a greater supply of self-employed individuals *per se*. Second, some factors are found significantly linked with self-employment, albeit different for non-Hungarian or Hungarian regions. Finally, some factors are irrelevant for self-employment. For instance, in non-Hungarian regions, long-term unemployment, female representation in the make-up of the labor force or urbanization are not determinants that would alone induce on average higher or lower self-employment rates. Hence, a policy with the aim of fostering self-employment in Czechia, Poland and Slovakia may be uniformly applied across regions with different concentrations of population, and cannot succeed by steps taken to curb long-term unemployment.

An obvious limitation of the present study is the omission of subsidies and non-financial support provided at a national level to unemployed persons, and especially long-term unemployed persons, under reactivation and start-up programs (Dvouletý, 2017; 2022). This support ranges from counseling and start-up training to financial assistance and subsidies. The differing intensity of these labor market policy measures may explain the differing pattern with which long-term unemployment is found a factor for self-employment in non-Hungarian regions and only Hungarian regions. Albeit the initial intention was to represent this factor in the analysis; it was not possible to compile a representative measure of such support across the V4 countries that would permit an international comparison. The reason being, the information provided by labor market institutions and governmental bodies in each V4 country in this regard is not unified and is selective in favor of some kind of policy instruments.

On the one hand, the present modeling framework accounts for the existence of interregional spatial effects that must exist – through the agency of various mechanisms – for the level of economic development, self-employment of neighboring regions, for which reason it overcomes traditional non-spatial approaches. On the other hand, the model is static and does not capture possible non-linear effects. Hence, it might be improved by accounting explicitly for time delays by including some of the predictors lagged. For instance, lagged unemployment might be used in both equations of model (1), or lagged self-employment might replace contemporaneous self-employment in the per-capita real gross domestic product equation. Yet, these characteristics display for individual regions a notable level of persistence, and no consensus must be sought concerning the extent of time delays applied. Another improvement in terms of specification follows from including non-linear squared terms or more advanced experimenting with the functional form. Nonetheless, this would have a flavor of data mining (Leamer, 1978).

A future challenge might refine the analysis by accounting for the demographic changes that has been taking place in the population and labor force of V4 regions upon unemployment and self-employment for the past few decades. For instance, during the investigated period, the working-age population was slowly shrinking, and youth unemployment persists to be higher with fluctuating patterns than unemployment of other age cohorts (Astrov, 2019; Fialová and Mysíková, 2021; Krzaklewska, 2013). These changes must also affect the mechanism of flows between employment, unemployment and self-employment.

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Appendix A

Table 4

Regional Composition of the Sample According to the NUTS 2021 Classification

V4 country	NUTS 2 regions
CZ Czechia	**CZ01** Prague, **CZ02** Central Bohemia, **CZ03** Southwest, **CZ04** Northwest, **CZ05** Northeast, **CZ06** Southeast, **CZ07** Central Moravia, **CZ08** Moravia-Silesia
HU Hungary	**HU11** Budapest, **HU12** Pest, **HU21** Central Transdanubia, **HU22** Western Transdanubia, **HU23** Southern Transdanubia, **HU31** Northern Hungary, **HU32** Northern Great Plain, **HU33** Southern Great Plain
PL Poland	**PL21** Malopolskie Voivodship, **PL22** Slaskie Voivodship, **PL41** Wielkopolskie Voivodship, **PL42** Zachodniopomorskie Voivodship, **PL43** Lubuskie Voivodship, **PL51** Dolnoslaskie Voivodship, **PL52** Opolskie Voivodship, **PL61** Kujawsko-Pomorskie Voivodship, **PL62** Warminsko-Mazurskie Voivodship, **PL63** Pomorskie Voivodship, **PL71** Lódzkie Voivodship, **PL72** Swietokrzyskie Voivodship, **PL81** Lubelskie Voivodship, **PL82** Podkarpackie Voivodship, **PL84** Podlaskie Voivodship, **PL91** Region Warszawski stoleczny, **PL92** Region Mazowiecki regionalny
SK Slovakia	**SK01** Bratislava Region, **SK02** Western Slovakia, **SK03** Central Slovakia, **SK04** Eastern Slovakia

Source: The authors.

Table 5

Declaration of Variables, Their Definition and Sources

Notation or code	Definition and units of measurement	Source[†)]
rgdpc_pc	Real gross domestic product (GDP) per capita (1000€, 2005 prices, total population)	E
selfer	Self-employment rate (%, to total labor force) [‡)]	E
ur	Unemployment rate (%) [‡)]	E
lt_ur	Long-term unemployment rate (%, to unemployed labor force) [‡)]	E
lfsh_f	Female ratio in labor force (%, to total labor force) [‡)]	E
lfsh_1524	Share of the age cohort 15 to 24 years in labor force (%)	E
lfsh_4564	Share of the age cohort 45 to 64 years in labor force (%)	E
popdens	Population density (persons per square kilometer, total population)	E
school1	Population with primary education (%) [‡)]	E
school3	Population with tertiary education (%) [‡)]	E
rde_perc	Gross domestic expenditure on research and development to GDP (%)	E
gvash_agr	Share of agricultural production in gross value added (%)	E
gvash_ind	Share of industrial production in gross value added (%)	E
gvash_cons	Share of construction production in gross value added (%)	E
eprot	Employee protection index (index)	O
gdpgap_ec	Economy-wide output gap (percentage point)[*)]	C(E)
gdprec_ec	Relative part of year with economy-wide recession (fraction between 0 and 1)[§)]	C(E)
taxself	Income tax per self-employed person relative to GDP per capita[#)]	E^T/E
publer	Employment rate in the public sector (%, to employed labor force) [‡)]	E
rgdp_dif	Real GDP annual growth rate (%, 2005 prices)	E

Notes: [†)] The data were updated as of March 2023. [‡)] The definition applies to persons in the age cohort 15 to 64 years (both in the numerator and denominator as appropriate). [*)] The Hodrick-Prescott filter was applied to quarterly economy-wide real GDP data, and quarterly output gap estimates were averaged to obtain annual output gap metrics. The filtration was implemented with a traditional value of the smoothing parameter 1,600 in combination with the extended Kaiser-Maravall's backcasting and forecasting procedure to ameliorate possible end-point distortions (cf. Boďa and Považanová, 2019; 2023). [§)] Hamilton's Markov-switching AR(2) model was utilized with quarterly economy-wide real GDP data to date business cycle to individual quarters (e.g. Hamilton, 1989; 2010), and the number of recessionary quarters in each year was divided by 4 to get the relative of the year affected by recessions. Hence, possible values were 0, 0.25, 0.50, 0.75, and 1.00. [#)] This income tax pertains to income from self-employment and also comprises social security contributions.

E indicates the Eurostat database <https://ec.europa.eu/eurostat/web/main/data/database>, E^T indicates the European Commission's reports on taxation trends for 2011 – 2022 <https://taxation-customs.ec.europa.eu/taxation-1/economic-analysis-taxation/data-taxation-trends_en>, O refers to the OECD.Stat database <https://stats.oecd.org>, C(·) means model-based computation from data obtained from the source declared in the bracket.

Source: The authors.

T a b l e 6

Descriptive Statistics of the Input Data

Variable	Mean	Median	StdDev	Min	Max	Mean	Median	StdDev	Min	Max
	CZ					**HU**				
rgdpc_pc	15.241	13.018	7.285	9.003	40.845	9.983	8.536	5.002	5.328	27.539
selfer	15.066	14.352	2.918	9.443	24.617	10.195	9.962	2.158	5.789	16.195
ur	5.874	5.300	3.143	1.300	15.200	7.659	8.100	3.296	1.800	16.500
lt_ur	40.957	41.500	11.305	11.000	64.300	44.476	44.700	8.588	18.800	59.500
lfsh_f	44.131	44.001	0.898	41.811	48.279	45.477	45.150	1.162	43.709	48.491
lfsh_1524	7.804	7.598	2.051	3.935	12.944	7.912	7.994	1.706	4.382	14.006
lfsh_4564	39.801	39.271	2.473	33.686	46.761	37.730	36.878	3.290	29.934	45.704
popdens	432.229	130.100	797.201	68.800	2714.300	502.721	88.200	1073.672	63.700	3461.900
school1	14.744	14.400	3.702	7.100	23.300	24.514	25.700	6.374	10.800	35.300
school3	15.553	13.350	7.689	5.600	41.800	17.739	15.300	8.006	10.500	44.100
rde_perc	1.330	1.275	0.703	0.220	2.940	0.893	0.670	0.581	0.220	2.550
gvash_agr	2.717	2.839	1.288	0.230	6.069	6.122	5.173	3.571	0.117	12.960
gvash_ind	34.107	37.037	8.999	10.029	43.774	29.121	26.514	9.148	10.837	45.484
gvash_cons	6.324	6.399	0.993	4.213	8.660	5.339	5.332	1.191	2.416	8.789
eprot	3.039	3.025	0.116	2.934	3.206	2.305	2.396	0.111	2.170	2.396
gdpgap_ec	–0.103	0.399	2.597	–7.450	5.220	–0.361	–0.779	2.254	–5.222	6.103
gdprec_ec	0.913	1.000	0.120	0.750	1.000	0.238	0.000	0.350	0.000	1.000
taxself	0.167	0.159	0.049	0.067	0.324	0.138	0.132	0.037	0.083	0.245
publer	21.126	20.533	2.390	17.189	31.131	24.087	23.156	4.037	16.485	32.587
rgdp_dif	2.050	2.610	3.620	–8.440	11.030	2.290	2.790	4.180	–13.600	10.720
	PL					**SK**				
rgdpc_pc	9.670	8.559	4.067	4.947	28.796	15.075	11.181	9.463	6.136	36.855
selfer	17.060	16.613	4.421	8.540	29.201	12.166	12.992	2.576	5.149	16.462
ur	10.709	9.500	5.972	1.800	27.400	11.940	11.150	6.036	2.500	25.000
lt_ur	39.921	38.400	11.893	12.600	71.000	59.821	65.300	12.868	21.500	83.200
lfsh_f	45.095	44.871	1.397	42.871	49.681	45.452	44.910	1.766	43.146	49.240
lfsh_1524	9.803	9.360	2.390	4.866	16.381	9.513	8.970	3.157	3.069	16.472
lfsh_4564	35.670	35.936	2.845	27.656	41.684	36.309	37.199	3.653	27.061	42.782
popdens	146.805	115.000	113.690	57.500	510.200	152.144	113.100	87.729	82.700	328.800
school1	18.624	18.650	4.831	7.500	29.100	16.285	15.800	4.005	8.600	23.800
school3	19.965	18.450	8.146	9.800	52.200	18.008	16.100	8.761	8.300	41.300
rde_perc	0.676	0.510	0.522	0.090	2.720	0.667	0.575	0.383	0.230	1.790
gvash_agr	3.958	3.834	2.415	0.561	11.304	2.295	2.609	1.051	0.374	4.105
gvash_ind	25.888	26.216	5.581	11.710	36.797	26.021	24.979	7.359	12.713	43.739
gvash_cons	7.752	7.650	1.031	4.660	10.800	7.808	7.420	2.476	3.863	12.523
eprot	2.504	2.482	0.051	2.482	2.625	2.991	3.135	0.236	2.665	3.385
gdpgap_ec	–0.604	–0.996	4.798	–9.732	9.045	–0.014	–0.111	2.218	–7.130	3.438
gdprec_ec	0.588	0.625	0.289	0.000	1.000	0.288	0.000	0.408	0.000	1.000
taxself	0.536	0.525	0.156	0.300	1.043	0.042	0.021	0.036	0.006	0.136
publer	21.306	21.243	2.474	15.594	29.228	24.296	24.600	3.044	18.092	30.840
rgdp_dif	3.270	3.510	2.260	–5.800	12.680	3.400	3.640	4.450	–8.740	14.840

Notes: Descriptive statistics were computed for the full sample stratified by countries.
"StdDev", "Min", and "Max" in the header denote standard deviation, minimum, and maximum, respectively.

Source: The authors.