MODELING OF REGIONAL INEQUALITY IN TERMS OF CONSUMPTION OF BASIC FOOD PRODUCTS IN UKRAINE

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Per capita food consumption is one of the most important indicators of a country's food security. The consumption of food products by the population must meet modern requirements of rational nutrition and provide a person with a full and productive life. The presence of significant differentiation between the regions of Ukraine, in particular in terms of food consumption, which has developed as a result of various socio-economic and historical conditions of regional development, can be very dangerous due to the threat of various kinds of social troubles and crises. The efforts of state and regional authorities in Ukraine should be aimed at reducing interregional inequality and ensuring a high level of quality of life for the population of the regions. The solution to this problem should be based on the study of the dynamics of regional inequality, including the study of the peculiarities of differentiation of the regions of Ukraine by the level of consumption of basic food products by the population. Such an analysis can be performed using convergence theory.

The aim of this paper is to study regional inequality in the levels of consumption of basic food products based on the theory of convergence, taking into account the spatial interaction of the regions of Ukraine. The need to take into account spatial effects is explained by the fact that regions are characterized by constant spatial interaction with each other, as a result of which, in empirical studies using regional data, regions should not be considered as isolated objects in space. Ignoring the spatial interaction between regions and using standard modeling methods can reduce the reliability and adequacy of the results obtained. Therefore, our analysis of convergence between the regions of Ukraine is based on the concept of β-convergence, which we estimate using spatial econometric models.

A number of works by foreign and Ukrainian scientists are devoted to the study of convergence and assessment of imbalances in the development of economic objects using mathematical and statistical methods [1-5]. At the same time, the convergence theory has not yet been used to analyze the consumption of food to the population of regions, taking into account the existence of spatial dependence between regions.

The study was conducted on the basis of statistical data from the State Statistics Service of Ukraine regarding the annual consumption of basic food products by regions of Ukraine per 1 person of the population. Statistics on the consumption of the following basic food products were considered: meat, milk, eggs, fish, sugar, oil, potatoes, fruits and cereals [6].

To identify spatial effects, we calculate the global Moran spatial autocorrelation index, which expresses the overall degree of similarity between spatially close regions in terms of consumption of basic food products [7]:

$$I = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\frac{1}{N}\sum_{i=1}^{N}(y_i - \bar{y})^2 \sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}}. \qquad (1)$$

where $N$is the amount of regions, $y_i$is the consumption of basic food group in region i, y_j is the consumption of basic food group in region j, $\bar{y}$– average value of the consumption of basic food group, $w_{ij}$are elements of the neighbors' weight matrix W. This matrix is a square symmetric matrix in size N×N, each element of which (w_{ij}) characterizes the proximity measure of objects i and j. We used the contiguity matrix as the weight matrix [8].The calculation results are presented in Table 1.

Table 1

The value of the global Moran's index for the regions of Ukraine by consumption levels of basic food groups[1]

	Meat	Milk	Eggs	Cereals	Potatoes	Vegetables	Fruits	Fish	Sugar	Oil
2000	0,115	0,651***	0,037	0,284**	0,453***	0,348***	-0,110	0,459***	0,219**	0,571***
2001	-0,005	0,644***	-0,038	0,288***	0,305***	0,222**	-0,039	0,452***	0,344***	0,597***
2002	-0,047	0,630***	-0,136	0,190***	0,534**	0,207**	-0,094	0,492***	0,340***	0,452***
2003	-0,08	0,624***	-0,161	-0,025	0,460***	0,270***	0,086	0,455***	0,637***	0,443***
2004	0,010	0,592***	-0,170	-0,021	0,497***	0,330***	0,136*	0,503***	0,527***	0,528***
2005	0,184**	0,553***	0,073	-0,020	0,423***	0,342***	0,155*	0,461***	0,624***	0,450***
2006	0,220**	0,526***	0,048	0,086	0,503***	0,332***	0,021	0,471***	0,512***	0,342***
2007	0,168*	0,589***	0,039	0,157*	0,518***	0,124*	0,017	0,442***	0,416***	0,182**
2008	0,211**	0,585***	0,118	0,098	0,377***	0,214**	-0,057	0,386***	0,409***	0,387***
2009	0,106	0,519***	0,162*	-0,102	0,446***	0,458***	-0,079	0,437***	-0,058	0,031
2010	0,160*	0,484***	0,262**	-0,265**	0,399***	0,452***	-0,022	0,443***	0,072	-0,092
2011	0,187**	0,510***	0,289***	-0,190	0,396***	0,450***	-0,022	0,450***	-0,079	-0,004
2012	0,225**	0,467***	0,277***	-0,205	0,381***	0,451***	0,054	0,508***	-0,205	0,014
2013	0,196**	0,527***	0,266***	-0,175	0,325***	0,385***	0,020	0,531***	-0,109	0,049
2014	0,245**	0,472***	0,257***	-0,210*	0,375***	0,362***	-0,059	0,422***	-0,127	0,176**
2015	0,127*	0,440***	0,365***	-0,059	0,441***	0,312***	0,005	0,485***	-0,094	0,355***
2016	0,117	0,322***	0,314***	-0,118	0,493***	0,203**	0,012	0,495***	-0,151	0,259**
2017	0,103	0,388***	0,256***	-0,198	0,520***	0,116	0,031	0,481***	-0,206	0,152*
2018	0,174**	0,356***	0,257***	-0,122	0,500***	0,275***	0,048	0,517***	-0,219*	-0,008
2019	0,158*	0,465***	0,275***	-0,053	0,562***	0,224**	0,118	0,569***	-0,158	-0,013

The presence of spatial autocorrelation was diagnosed for all food groups. The influence of neighboring regions on the level of consumption of products such as meat, eggs, cereals, fruits, sugar, and butter was diagnosed only in some years. A statistically significant and positive Moran index means that the level of food

1The significance of indicators in the table is marked as follows: for p-value < 0,01 - ***, for p-value < 0,05 - **, for p-value < 0,1 - *.

consumption in a particular region is influenced by neighboring regions, and this influence is positive.

The simplest regression to detect β-convergence can be represented as follows:

$$\frac{\ln y_{iT} - \ln y_{i0}}{T} = a + b \cdot y_{i0} + \varepsilon_i \quad , \tag{1}$$

де y_{i0} – value of the studied indicator for the object $i$in the initial time period; y_{iT} – value of the indicator i in the final period T ; a , b – parameters of the regression model to be evaluated; ε_i -random errors. An indicator of the presence of convergence is the sign of the parameter b : if $b<0$ – there is convergence, if $b>0$ – there is divergence.

Model (2) treats regions as isolated objects and does not allow us to take into account the spatial interaction of regions. Therefore, to take into account the spatial dependence between regions, we will use spatial econometric models, namely spatial error models, which, according to [9], are appropriate to use while modeling β-convergence. In general, the spatial error model for estimating β-convergence has the form [9]:

$$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha + \beta \ln\left(y_{i,t-1}\right) + \lambda \sum_{j=1}^{n} W \cdot \varepsilon_{j,t} + \eta_i \tag{2}$$

де λ – the spatial autocorrelation coefficient of the error term, η_i –random errors. The statistical significance and sign of the parameter λ allow us to conclude that the value of the dependent variable in region *i* is influenced by random and unaccounted in the model factors in neighboring regions. The following results of estimating β-convergence models are obtained based on Equation (2):

Meat	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}208 \cdot \ln\left(y_{i,t-1}\right) + 0{,}741 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$
Milk	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}217 \cdot \ln\left(y_{i,t-1}\right) + 0{,}698 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$
Eggs	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}267 \cdot \ln\left(y_{i,t-1}\right) + 0{,}481 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$
Cereals	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}251 \cdot \ln\left(y_{i,t-1}\right) + 0{,}579 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$
Potatoes	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}316 \cdot \ln\left(y_{i,t-1}\right) + 0{,}486 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$
Vegetables	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}154 \cdot \ln\left(y_{i,t-1}\right) + 0{,}501 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$
Fruits	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}256 \cdot \ln\left(y_{i,t-1}\right) + 0{,}660 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$
Fish	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}359 \cdot \ln\left(y_{i,t-1}\right) + 0{,}819 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$

Sugar $\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}307 \cdot \ln\left(y_{i,t-1}\right) + 0{,}623 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$

Oil $\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = -0{,}158 \cdot \ln\left(y_{i,t-1}\right) + 0{,}667 \cdot \sum_{j=1}^{n} W \cdot \varepsilon_{j,t}$

All coefficients of the model are statistically significant at 0.05. it is obtained that convergence exists for all basic products. It is also obtained that the spatial parameter λ, which characterizes the generalized influence of random and unaccounted-for factors in the model for neighboring regions, is positive and statistically significant for all food groups. That is, if we study convergence taking into account the existence of spatial dependence between regions, then the level of consumption in a particular region is affected by random shocks that occurred in neighboring regions, and factors that are not taken into account in the model that affect consumption in neighboring regions.

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ECONOMIC POLICY UNCERTAINTY AND ITS FOREIGN TRADE IMPACT

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Economic policy uncertainty (EPU) plays a critical role in driving macro-economic variables and this has been one of the most widely discussed issues among academics and policy makers amidst the ever-growing literature in this area. One particular aspect of EPU that has garnered attention is the prevalence of persistence in the EPU series and its resulting impact on EPU related studies. As per (Plakandaras, Gupta, & Wohar, 2019), a more persistent uncertainty series would take longer to revert to its long run equilibrium, and hence the more prolonged would be a negative impact on the economy. They investigated 72 popular uncertainty indices and found persistence in all these indices. They state that the impact of uncertainty is likely to be non-constant over time and should be best studied using time-varying frameworks. We use the Bayesian Vector Autoregression with stochastic volatility and time varying parameters (BVARSV-TVP) to factor in the time varying characteristic of EPU impact. (Gil-Alana & Payne, 2019) using fractional integration techniques, measured the degree of persistence for the US EPU index and concluded that the shocks are persistent but mean reverting. As per (Joel, Abakah, Caporale, & Gil-alana, 2020), EPU is in most cases a non-stationary, mean reverting series characterised by a long memory and is inherently persistent. Therefore, in this paper the Indian EPU series is made stationary to cancel out the persistence and observe the impact on the exports. With reduced EPU persistence, the export (EXP) performance of the Indian pharma industry (bulk drugs and fine chemicals) needs to improve which is the hypothesis that is tested in this paper.

As cited in literature below, policy uncertainty especially EPU tends to negatively impact economic growth and exports. Therefore, along with exports, we have Indian GDP growth (GDP) as an endogenous variable in the BVARSV-TVP model. It would also be interesting to observe the impact on GDP growth from an EPU series with reduced/zero persistence.