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AN ASSESSMENT OF THE INFLUENCE OF THE NUMBER OF MICRO-ENTERPRISES ON THE UNEMPLOYMENT RATE IN POLAND WITH THE USE OF PANEL MODELS

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K e y w o r d s: micro-enterprise, unemployment, panel model.

A b s t r a c t

Small and medium-sized enterprises, in particular, micro-enterprises play an important role in generating gross value added as well as in job creation. The objective of the study is to evaluate the dependence between the number of micro-enterprises and the rate of unemployment in particular provinces in Poland in the years 2004–2014. The paper includes an analysis of cross-sectional and time series data using panel models. The conducted analysis showed that, as expected, a negative relationship exists between the number of micro-enterprises and the unemployment rate.

OCENA WPŁYWU LICZBY MIKROPRZEDSIĘBIORSTW NA STOPĘ BEZROBOCIA W POLSCE Z ZASTOSOWANIEM MODELI PANELOWYCH

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S ł o w a k l u c z o w e: mikroprzedsiębiorstwo, bezrobocie, model panelowy.

A b s t r a k t

Małe i średnie przedsiębiorstwa, w tym szczególnie mikroprzedsiębiorstwa, odgrywają istotną rolę w wytwarzaniu wartości dodanej brutto oraz tworzeniu miejsc pracy. Celem opracowania jest ocena zależności między liczbą mikroprzedsiębiorstw a stopą bezrobocia w poszczególnych województwach w Polsce w latach 2004–2014. W opracowaniu przeanalizowano dane przekrojowo-czasowe za pomocą modeli panelowych. Przeprowadzona analiza wykazała, że – zgodnie z oczekiwaniami – występuje ujemna zależność między liczbą mikroprzedsiębiorstw a stopą bezrobocia.

Introduction

The share of entities from the sector of small and medium-sized enterprises in generating gross value added in the 28 European Union member states is at a level close to 58%. This proportion in Poland is slightly lower and fluctuates around 50% (HUTERSKA et al. 2015, p. 615). However, it is extremely important. According to the Central Statistical Office, in 2014 small and medium-sized enterprises accounted for 99.8% of the total of non-financial companies operating in Poland, and the participation of micro-enterprises amounts to 95.8% (*Działalność przedsiębiorstw niefinansowych* 2015). Participation of small and medium-sized enterprises in the generation of GDP is also significant. In 2012, it reached the level of 48.5%, and micro-enterprises had the largest share (30%) in the generation of GDP (ŁAPIŃSKI et al. 2015, p. 15).

The Act of July 2, 2004 on the Freedom of Economic Activity (Ustawa z 2 lipca 2004 r. o swobodzie działalności gospodarczej, DzU z 2004 r., nr 173, poz. 1807, as amended) defines a micro-enterprise (in Article 104) as an enterprise which in at least one of the last two financial years employed on average up to nine employees and generated an annual net turnover from the sale of goods, products, services, and financial operations not exceeding the PLN equivalent of 2 million euros, or its total assets in one of the last two financial years did not exceed the PLN equivalent of 2 million euros.

Micro-enterprises in the main (*i.e.*, 98.1%) are owned by individuals. Given the possibility of obtaining financing from EU funds for individuals starting business activity, as well as tax relief in the first years of this activity, microenterprises are a way to create a place of work for job seekers (*Działalność przedsiębiorstw niefinansowych* 2015, p. 29).

Due to the important role played by this type of enterprise in the economy, the article attempts to examine the dependence between the number of entities defined as micro-enterprises and the rate of unemployment in particular provinces in Poland.

The research objective of this study is the assessment of the influence of the number of micro-enterprises on the unemployment rate in individual provinces in Poland. The research method is an analysis of cross-sectional and time series data using panel models. The study employed data published by the Central Statistical Office on unemployment and the number of micro-enterprises in Poland by province for the time period 2004–2014.

Methodology

In this paper, panel models were used in analyzing cross-sectional data. In the subject literature, panel data are usually related to cross-sectional

and time series data (*Ekonometria współczesna* 2007, p. 409). According to G.S. Maddala, panel data are the data "with which we deal when we have the information on specific cross-sectional units covering a longer period of time (of more than one period)" (MADDALA 2006, 2008, p. 643). T. Kufel interprets panel data as data "which can be observed in at least two dimensions" (KUFEL 2007, p. 164) and he points to cross-sectional and time series data as the best example. In B. Dańska-Borsiak's opinion, panel data constitute a particular type of time-series-cross-section data in which the number of objects N exceeds (sometimes to a great extent) the number of points in T (DAŃSKA-BORSIAK 2011, p. 14).

Panel data are categorised into balanced and unbalanced panels (*Ekonometria współczesna* 2007, p. 410). The balanced panel is the information on a constant group of items (such as, for instance, countries, regions, industries, businesses, households, etc.) throughout the period analysed. If a group of items in the period under consideration is subject to change (*i.e.,* further new items are added, or certain items are removed), then we deal with the unbalanced panel.

Models based on panel data (*i.e*., panel models) allow a description of the dependence between economic phenomena in both time and spacial dimensions. These models take into account national, regional, or industry differentiation over time. The results of empirical studies based on these models are an important source of information for economic decision-makers (individuals and institutions).

The examined items are affected by two types of factors (*Ekonometria współczesna* 2007, p. 410):

– factors affecting all the tested items equally,
– factors affecting individual tested items in a specific manner.

For the purpose of estimating panel data models, the following can also be applied:

– ordinary least squares estimator (OLS),
– fixed effect estimator (FE),
– random effect estimator (RE).

The OLS estimator is used when all the items included in the study are homogeneous and the differences between the empirical and theoretical values of the dependent variable are only a consequence of the random component (*Ekonometria współczesna* 2007, p. 410).

The FE and RE estimators are used in case of sample heterogeneity. The source of sample heterogeneity is individual effects. The FE estimator assumes that individual effects are non-random and can be estimated. However, in the case of the RE estimator it is assumed that individual effects are random and they form part of the random component. In this case, the individual effects

cannot be estimated, only their dispersion can be estimated (*Ekonometria współczesna* 2007, p. 411–416, DAŃSKA 1995, p. 4).

When choosing the panel model (a simple model, *i.e.*, without individual effects or models with one-way individual effects, *i.e.*, FEM – fixed effect model, or REM – random effect model) the following tests are used: the Wald test, the Breusch-Pagan test, and the Hausman test. These tests allow the correctness of the estimated model to be evaluated. A discussion of these tests can be found in an abundance of econometric literature (KUFEL 2007, p. 166, 170–171, MADDALA 2006, 2008, p. 649–650, *Ekonometria współczesna* 2007, p. 416–418).

Empirical Results

In order to describe the dependence between the number of micro-enterprises and unemployment in Poland, a panel model was used in this study. Data were collected for 16 provinces in Poland, and they relate to a period of 11 years (annual data for 2004–2014). The study used data published by the Central Statistical Office in its reports entitled "Financial companies" and "Unemployment". The study concerns the 2004–2014 time period.

Let the following be:

y_{it} – the unemployment rate in the i-th province in t period (shown as %),
x_{it} – the number of micro-enterprises in the i-th province in t period,
i – the number of the province ($i = 1, 2, ..., 16$),
N – the total of the provinces ($N = 16$),
t – the number of the period ($t = 1, 2, ..., 11$).
T – the total of the periods ($T = 11$).

A simple panel model (without individual effects), estimated by means of OLS takes the following form:

$$\hat{y}_{it} = 17.981 - 0.000031x_{it} \qquad (1)$$
$$(0.542)\ (0.00000435)$$

The sum of the squared model residuals is $\sum_{i=1}^{16}\sum_{t=1}^{11} e_{it}^2 = 2{,}544.928$. The determination coefficient $R^2 = 22.6\%$. This result indicates a rather low level of explanation of the formation of the endogenous variable estimated by the simple model.

Table 1 shows the average values of the unemployment rate in each of the provinces. Noticeable differences concern the constant value estimated for all panel data (see model 1).

Table 1

The average unemployment rates in individual provinces in Poland (data for 2004–2014)

Province	Average unemployment rate (in %)
Dolnośląskie	14.21
Kujawsko-Pomorskie	17.08
Lubelskie	14.33
Lubuskie	16.74
Łódzkie	13.85
Małopolskie	10.89
Mazowieckie	11.55
Opolskie	14.75
Podkarpackie	16.05
Podlaskie	13.53
Pomorskie	13.66
Śląskie	11.11
Świętokrzyskie	16.63
Warmińsko-Mazurskie	21.65
Wielkopolskie	10.11
Zachodniopomorskie	19.24

Source: elaborated by the authors based on *Liczba bezrobotnych zarejestrowanych...* (2016).

A model with fixed effects (FEM), estimated by OLS takes the following form:

$$\hat{y}_{it} = 29.272 - 0.000138x_{it} \tag{2}$$

$$(4.0246)\ (0.0000381)$$

The sum of the squared model residuals is $\sum_{i=1}^{16}\sum_{t=1}^{11} e_{it}^2 = 1{,}552.313$.

Table 2 shows the estimates of individual fixed effects for specific provinces.

Table 2

The estimated individual fixed effects for specific provinces

Province	Evaluations of individual effects (in %)
Dolnośląskie	32.28
Kujawsko-Pomorskie	28.21
Lubelskie	24.21
Lubuskie	22.70
Łódzkie	29.61
Małopolskie	31.78
Mazowieckie	50.35
Opolskie	19.69
Podkarpackie	25.17
Podlaskie	19.27
Pomorskie	28.99
Śląskie	38.80
Świętokrzyskie	22.87
Warmińsko-Mazurskie	28.90
Wielkopolskie	33.67
Zachodniopomorskie	31.85

Source: elaborated by the authors based on *Małe i średnie przedsiębiorstwa...* (2015), *Liczba bezrobotnych zarejestrowanych...* (2016).

The estimated (generalized least squares – GLS) form of the model with random effects (REM) takes the following form:

$$\hat{y}_{it} = 18.514 - 0.000036x_{it} \qquad (3)$$

$$(0.000)\ (0.00000914)$$

The sum of the squared model residuals is $\sum_{i=1}^{16}\sum_{t=1}^{11} e_{it}^2 = 2{,}564.66$.

Table 3 shows the results of the Wald, Breusch-Pagan, and Hausman tests based on which the decision to choose the right model was made. These tests allow verification of the assumptions with regards to the correctness of the panel model estimation.

Table 3

The results of the Wald, Breusch-Pagan, and Hausman tests

Test	Hypotheses	Test statistic	p value	Decision*
The Wald's test	H_0: the homogeneous model constant terms, independent of the item and time (OLS estimator) H_1: the heterogeneous terms for individual items, but constant over time (FE estimator)	$F = 6.7781$	$p \approx 0.000$	Rejection of H_0
The Breusch--Pagan's test	H_0: the variance of the random component of individual effects insignificantly differs from zero (OLS estimator) H_1: the variance of the random component of individual effects significantly differs from zero (RE estimator)	$LM = 76.9538$	$p \approx 0.000$	Rejection of H_0
The Hausman's test	H_0: both FE and RE estimators are unbiased (RE estimator is more effective) H_1: FE estimator is unbiased but RE estimator is biased (FE estimator)	$\chi^2 = 7.2221$	$p \approx 0.00545$	Rejection of H_0

* The adopted level of significance is 0.05 (*i.e.*, $\alpha = 0.05$).
Source: elaborated by the authors based on the data contained in Tables 1 and 2.

Analysing the results of the Wald test, it can be stated that the appropriate model to describe the dependence between the number of micro-enterprises and the unemployment rate is the fixed effects model (FEM). The results of the Breusch-Pagan test indicate the random effects model (REM) is the better model. Finally, the results of the Hausman test allow the authors to conclude, assuming risk error at a 0.05 level ($\alpha = 0.05$), that the appropriate model for describing the examined dependence is the fixed effects model (FEM); which is model (2).

In the next section, the study presents the interpretation of the evaluation of the parameters of the fixed effects model. The differences between the estimates of the individual effects and the average unemployment rate in specific provinces are very helpful in the interpretation of the individual effects. They are presented in Table 4.

Table 4
The differences between the evaluations of the individual effects and the average unemployment rate in the surveyed provinces

Province	Difference
Dolnośląskie	18.07
Kujawsko-Pomorskie	11.13
Lubelskie	9.88
Lubuskie	5.96
Łódzkie	15.75
Małopolskie	20.89
Mazowieckie	38.79
Opolskie	4.95
Podkarpackie	9.13
Podlaskie	5.75
Pomorskie	15.33
Śląskie	27.69
Świętokrzyskie	6.25
Warmińsko-Mazurskie	7.25
Wielkopolskie	23.56
Zachodniopomorskie	12.61

Source: elaborated by the authors based on the data contained in Tables 1 and 2.

The evaluation of the parameter of the explanatory variable (-0.000138) is interpreted as follows: if the number of micro-enterprises increases by one enterprise, then the unemployment rate (due to the increase) falls on average by 0.000138 of a percentage point. The interpretation of the evaluation of the individual effect of the Dolnośląskie province (see Tables 1, 2 and 4) is as follows: if there are no micro-enterprises in the Dolnośląskie province, then the average annual unemployment rate in this province is 32.28%, and is higher than the real annual average unemployment rate for this province by 18.07 of a percentage point. A similar interpretation is given for the remaining evaluations of individual effects.

Conclusion

The analysis confirmed the existence of a negative dependence between the number of micro-enterprises and the unemployment rate. It can also be stated that the greatest influence of the number of micro-enterprises on the unemployment rate can be observed in the following provinces: Mazowieckie,

Śląskie, and Wielkopolskie, and that these are highly urbanized and industrialized provinces. The lowest effect, in turn, can be noted in the Opolskie, Podlaskie, and Lubuskie provinces.

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