

GRAŻYNA KOWALEWSKA¹, LESŁAW MARKOWSKI²,
ANNA RUTKOWSKA-ZIARKO³, JOHN SIMSTER⁴

Polish Migration Trends to the United Kingdom: Econometric Evidence

1. Introduction

The most common reason for migration – not only among Polish people – are economic factors: the desire to find better or any kind of work, and thus improve the situation. It is logical that this flow has run and runs towards countries with a better economic situation in which the chance of finding a job is high (low unemployment, and high wages).

Poland's membership in the European Union allows the free flow of resources: capital, technology and people. Most EU countries fearing a flood of their labour markets, cheap labour from Central and Eastern Europe, including the Polish, introduced the so-called "transitional periods". Great Britain was one of the first countries after 2004 to become fully open to immigration from Poland whereas Germany and Austria prevented Polish immigration for the maximum period of 7 years from the date of 1st May 2004 (the adoption of the new member states)⁵. Germany and Austria made their decisions under the pressure from trade unions.

From 1st May 2004, the United Kingdom, Ireland and Sweden decided that the labour markets are not closed for migrant workers from the EU-8 (including Poland). The main reason for opening the markets in these countries was the demand for labour, and job vacancies in many sectors, including construction,

¹ Chair of Quantitative Methods, Faculty of Economics, University of Warmia and Mazury in Olsztyn, Poland.

² Chair of Quantitative Methods, Faculty of Economics, University of Warmia and Mazury in Olsztyn, Poland.

³ Chair of Quantitative Methods, Faculty of Economics, University of Warmia and Mazury in Olsztyn, Poland.

⁴ Accounting, Finance & Economics Department, Business School, Manchester Metropolitan University, UK.

⁵ Organiściak-Krzykowska, A. & Machnis-Walasek, J. (2014). *Edukacyjne uwarunkowania powrotów Polaków z emigracji zarobkowej*. Acta Universitatis Lodziensis. Folia Oeconomica, 72.

catering, hospitality management, care for children and the elderly. Many of these vacancies were quickly filled by the citizens from the newly-accepted member states in Central and Eastern Europe, including Poland⁶. According to the Annual Population Survey in 2004, there were just 95,000 Polish people in the UK; in 2010, this increased to 550,000 Polish-born residents in the UK. The 'pull' factors for Poles moving to the UK were the demand for work, much higher salaries, and much higher benefits for families in the UK compared to those offered in Poland. A positive aspect of the influx of Polish migrants was not only an increase in employment and the development of specific industries, but also the development of the outermost regions of the UK.

The article focuses on the statistical and econometric analysis/comparison of the percentage of Poles living in some selected regions of the UK. The purpose of this article is to compare migration between Poland and the UK, to locate the most popular regions in the migration of Poles in the UK and to analyse the major causes of economic migration.

2. Literature Review

The profile of migrants from Poland shows that they are generally young people, relatively highly educated, and who have higher rates of participation in the labour market than the UK population.

In 2004, Poles migrated to the UK because in Poland unemployment was high: about 20%⁷. Unemployment was an important factor to 2006, when the unemployment rate fell to about 10%. Since the onset of the recession, unemployment has risen somewhat in Poland; it remains at about 10%, just below the EU average. However, after 2006 unemployment has not played a major role in migration, but a higher standard of living and the possibility of saving money from one's pay.

Most migrants from Poland do not plan to stay in the UK for more than four years. It is not permanent migration, but temporary migration. The difference between temporary or permanent migration is that temporary migrants retain

⁶ Organiściak-Krzykowska, A. & Machnis-Walasek, J. (2014). *Edukacyjne uwarunkowania powrotów Polaków z emigracji zarobkowej*. Acta Universitatis Lodziensis. Folia Oeconomica, 72.

⁷ International Passenger Survey. *Table 3.17 Intended Length of Stay by Country of the Last or Next Residence*. Retrieved from: <http://www.migrationwatchuk.org/briefing-paper/257>

their residence in the country of origin, whereas permanent migrants do not⁸. Previous literature often referred to one specific form of temporary migration: seasonal one, where a migrant works in the UK during certain times of the year – associated with agricultural work⁹.

An important role in Polish migration is played by the experience of relatives, neighbours and friends. A person is more likely to migrate from one country to another if there is a network of people from the country of origin who live in the host country¹⁰. Polish migration to the UK is an example of the “spill-over” of migrants from London, due to the development of migrant networks, which consist of informal contacts: among migrants, and between migrants and employers, as well as recruitment agencies and transport companies. The development of migrant networks is made possible by the existence of demand for foreign workers – demand often met by Poles¹¹.

Immigrants and would-be migrants are the best source of information about the benefits of accepting migration and the ways to avoid problems¹². They can also provide financial assistance to help find a job and get acclimatized, and thus reduce the costs of migration in all its dimensions: economic, social and psychological¹³. Migration can be self-perpetuating. The mere existence of former migrant communities in a country can be the basis for forecasts for the direction of future cash flows; migration should be seen as a chain of feedbacks, and not as a collection of individual, mutually independent flows¹⁴. The awareness of the existence of such links combines the conventional neoclassical economic

⁸ Government Population Council (2011). *Sytuacja demograficzna Polski. Raport 2010–2011 [Demographic Situation of Poland, 2010–2011 Report]*. Warsaw, 157–9; Okólski M. (2005). *Demografia. Podstawowe pojęcia, procesy i teorie w encyklopedycznym zarysie*. Wyd. Naukowe-Scholar, Warszawa, 82–3.

⁹ Organiściak-Krzykowska, A. & Machnis-Walasek, J. (2014). *Edukacyjne uwarunkowania powrotów Polaków z emigracji zarobkowej*. Acta Universitatis Lodziensis. Folia Oeconomica 3(303), 82.

¹⁰ Kurekova, L. (2011). *Theories of Migration: A Conceptual Review and Empirical Testing in the Context of the EU East-West Flows*. Paper prepared for the Interdisciplinary Conference on Migration. Economic Change, Social Challenge. 6th to 9th April 2011, University College London, UK, 10.

¹¹ Fihel, A. & Piętka, E. (2007). *Funkcjonowanie polskich migrantów na brytyjskim rynku pracy*. Formerly ISS WORKING PAPERS, seria: PRACE MIGRACYJNE, No 23/81, Centre of Migration Research, Faculty of Economic Sciences: Warsaw University.

¹² Janicki, W. (2014). *Przegląd teorii migracji ludności*. UMCS Lublin.

¹³ Arango, J. (2000). Explaining Migration: A Critical View. *International Social Science Journal*, 52(165), 283–296.

¹⁴ Hannerberg, D. & Hägerstrand, T. (Eds.) (1957). *Migration in Sweden: A Symposium*. Lund Studies in Geography: Series B. *Human Geography*, 13. Lund: CWK Gleerup.

theory with the economic migration networks world-system theory, assuming the ties between countries are due to migrants forming ties on an individual basis. This theory can explain the differences in the size of migration to the centers of identical attractiveness, as well as explain the existence of intense migration to the countries with a restrictive immigration policy of family reunification process and return migrations. The disadvantage of this theory is its inability to identify the causes of migration in the first direction, and the failure to take account of economic factors determining the varying intensity of the population flow.

The neoclassical economic theory focuses on wage differences and probability of obtaining work as a motive for migration; it considers the costs, as well as benefits, of migration¹⁵. This theory ignores many factors which recent researchers consider important explanations for migration, such as politics. The 'new economics theory' of migration includes a wider range of factors than is usually assumed by neoclassical economists – such as family influences on a person considering migration¹⁶.

The neoclassical economic theory was popular before the late 1970s: it assumed migration can increase utility as migrants increase their own income. It included the 'equilibrium perspective', in which higher-wage locations are associated with higher costs of living, and hence migration may not make a migrant happier^{17,18}. Okólski¹⁹ considers migration to be caused by imperfections in the market mechanism within a country – labour mobility between countries improves the allocation of labor, thereby reducing inequality on a global scale.

¹⁵ Kurekova, L. (2011). *Theories of Migration: A Conceptual Review and Empirical Testing in the Context of the EU East-West Flows*. Paper prepared for the Interdisciplinary Conference on Migration. Economic Change, Social Challenge. 6th to 9th April 2011, University College London, UK, 5.

¹⁶ Kurekova, L. (2011). *Theories of Migration: A Conceptual Review and Empirical Testing in the Context of the EU East-West Flows*. Paper prepared for the Interdisciplinary Conference on Migration. Economic Change, Social Challenge. 6th to 9th April 2011, University College London, UK, 7

¹⁷ Greenwood, M.J. (2005) *Modeling Migration*. In: Encyclopedia of Social Measurement Volume 2, ed. K. Kempf-Leonard, . Amsterdam, Elsevier, 726–7.

¹⁸ Bodvarsson, Ö.B. & Van den Berg, H. (2013). *The Determinants of International Migration: Theory*. Chapter 2, in: *The Economics of Immigration: Theory and Policy*, DOI 10.1007/978-1-4614-2116-0_2, Springer Science + Business Media, New York; Okólski, M. (2005). *Demografia. Podstawowe pojęcia, procesy i teorie w encyklopedycznym zarysie*. Wyd. Naukowe Scholar, Warszawa.

¹⁹ Okólski, M. (2005) *Demografia. Podstawowe pojęcia, procesy i teorie w encyklopedycznym zarysie*. Wyd. Naukowe Scholar, Warszawa, 231–2.

Some writers (e.g. Espíndola et al.²⁰) use a more complicated model, based on the ideas of Harris and Todaro: they assume each person acts rationally, attempting to obtain the maximum expected income. Espíndola et al. simply report that their model is consistent with “the crucial assumption of Harris and Todaro, that the rural-urban migration will occur while the urban expected wage will exceed the rural wage”²¹.

Gravity models of migration assume people tend to seek higher wages; but as Górny & Kaczmarczyk wrote²², this should refer only to large aggregates. Gravity models may continue to be useful for some migration research, but there seems to be a need for other models. Górny & Kaczmarczyk claim the use of gravity models can be justified to test the macroeconomic theory, assuming that a homogeneous population is studied, and a primary cause factor are different rates of pay²³.

The ‘Human Capital Theory’ builds on neoclassical economics, claiming ‘human capital’ (education, skills, etc.) affect the likelihood of migration²⁴. Łobacz et al.²⁵ claim there are various reasons for migration, in addition to earning money: for vocational training, to improve language skills, and to satisfy a migrant’s own aspirations and ambitions of a career development. Many of well-educated Polish people cannot find appropriate work in Poland, so they decide to emigrate²⁶.

²⁰ Espíndola, A.L., Silveira, J.J. & Penna, T.J.P. (2006). A Harris-Todaro Agent-Based Model to Rural-Urban Migration. *Brazilian Journal of Physics* 36 (3a), 603–608.

²¹ ibidem, p. 608.

²² Górny, A. & Kaczmarczyk, P. (2003). *Uwarunkowania i mechanizmy migracji zarobkowych w świetle wybranych koncepcji teoretycznych*. ISS WP 2003, Seria: Prace migracyjne, nr 49, 15.

²³ ibidem, p. 16.

²⁴ Kurekova, L. (2011). *Theories of Migration: A Conceptual Review and Empirical Testing in the Context of the EU East-West Flows*. Paper prepared for the Interdisciplinary Conference on Migration. Economic Change, Social Challenge. 6th to 9th April 2011, University College London, UK, 6.

²⁵ Łobacz, K., Klimek, J., Majchrzak, M. & Niedzielski, P. (2012). *Migranci na rynku pracy w wybranych krajach Europy: wsparcie formalno-prawne i organizacyjne [Migrants on the Labour Market within Selected European Countries: The Legal Context and Organisational Support]*. European Migrant Adviser Toolkit.

²⁶ Anacka, M., Brzozowski, J., Chałupczak, H., Fihel, A., Firlit-Fesnak, G., Garapich, M., Grabowska-Lusińska, I., Heffner, K., Jaźwińska, E., Jończy, R., Kaczmarczyk, P., Krzyżowski, Ł., Lesińska, M., Okólski, M., Praszałowicz, D., Rauziński, R., Rokita-Poskart, D., Slany, K., Solga, B., Ślusarczyk, M. & Urbańska, S. (2014) *Společne skutki poakcesyjnych migracji ludności polski: raport komitetu badań nad migracjami polskiej akademii nauk*. Warszawa, 24–5.

Okólski²⁷ and Professor Organiściak-Krzykowska²⁸ use the ‘push-pull factors’ model: the flow of migrants is a function of ‘push’ factors (which encourage people to leave one location), and ‘pull’ factors (which attract migrants to a new location). In addition, there are so-called indirect obstacles (intervening obstacles); they may be minor or decisive in preventing mobility; this is mainly related to political aspects²⁹. We can consider a number of extensions to the model: e.g. people are more likely to move to a country with a relatively low cost of living³⁰. However, there are practical problems with such models: there are thousands of possible factors which might seem relevant, such as access to schools considered suitable or quality of housing – many of these factors are difficult or impossible to measure. This theory sheds light on why so many Poles move to the UK: for example, people are more likely to move to a country with relatively low costs of living. The ‘push and pull’ framework has been criticized for its inability to determine which factors are the most important influences³¹. Łobacz et al³² claim there are various reasons for migration, such as the purchase of housing. Bodvarsson & Van den Berg³³ discuss other factors which make analysing migration more complicated, such as uncertainty about earnings in another country; potential to reduce housing costs by staying with relatives or friends in a new country; and families where the husband & wife both earn, but disagree about where they could earn most.

M. Kupiszewski analysed the impact of international migration on the population and labour force resources. He introduces scenarios of future international

²⁷ Okólski, M. (2005). *Demografia. Podstawowe pojęcia, procesy i teorie w encyklopedycznym zarysie*. Wyd. Naukowe Scholar, Warszawa, 232.

²⁸ Organiściak-Krzykowska, A. (2013). *Contemporary Conditions and Directions of Migration in Poland: Returns from Migrating to the Annual Operating on the Market Situation to Poland*. UWM Publishing: Olsztyn, 16–17.

²⁹ Górny & Kaczmarczyk, (2003), 40.

³⁰ Organiściak-Krzykowska, A. (2015) *Reasons for and Directions in Poles’ Temporary Migrations*. PowerPoint presentation: University of Warmia and Mazury in Olsztyn, Poland.

³¹ Kurekova, L. (2011) *Theories of Migration: A Conceptual Review and Empirical Testing in the Context of the EU East-West Flows*. Paper prepared for the Interdisciplinary Conference on Migration. Economic Change, Social Challenge. 6th to 9th April 2011, University College London, UK, 6.

³² Łobacz, K., Klimek, J., Majchrzak, M. & Niedzielski, P. (2012). *Migranci na rynku pracy w wybranych krajach Europy: wsparcie formalno-prawne i organizacyjne [Migrants on the Labour Market within Selected European Countries: The Legal Context and Organisational Support]*. European Migrant Adviser Toolkit.

³³ Bodvarsson, Ö.B. & Van den Berg, H. (2013). *The Determinants of International Migration: Theory*. Chapter 2, in: *The Economics of Immigration: Theory and Policy*, DOI 10.1007/978-1-4614-2116-0_2, Springer Science + Business Media, New York.

migration. These simulations have been made in order to estimate the size of replacement migration needed to balance labour market parameters in the countries of Europe³⁴. As one of the barriers to migration Kupiszewski mentioned the lack of knowledge of the language and customs of the target country of migration (ethno-cultural barriers)³⁵. He stresses that it is often omitted in the theories of migration and migration policy of the state³⁶. Since the European Union lacks a uniform definition of migration and a migrant, data on this phenomenon presented in various forms and registration of migration is carried out according to different criteria, depending on the country where the measurements are taken³⁷. Arkadiusz Wiśniowski investigates the forecasts on migration flows from Poland to the UK in a Bayesian modelling³⁸.

Economists often use regression to assess such factors; but assessing the effects of relative wages would be complicated because wages vary over time (in response to periods of recession, for example), and the appeal of another country's wage rate is affected by exchange rates – which vary all the time. There are practical problems with regression in such cases, because various variables interact – for example, if a large number of people moved from Poland to the UK, this may raise the average wage rates in Poland and reduce the wages in the UK, because the supply of labour varies; but Polish workers would take skills with them, which would tend to make the UK more productive and hence could increase UK exports and the demand for labour in the UK.

³⁴ Kupiszewski, M. (Ed.) (2013). *International Migration and the Future of Populations and Labour in Europe*. The Springer Series on Demographic Methods and Population Analysis, 35–55

³⁵ Kupiszewski, M. (2001). *Demograficzne aspekty wybranych prognoz migracji zagranicznych, [w:] Swobodny przepływ pracowników w kontekście wejścia Polski do Unii Europejskiej*. (Ed.) A. Stępiak, UKiE, 73–98.

³⁶ Kupiszewski, M. (2002). Modelowanie dynamiki przemian ludności w warunkach wzrostu znaczenia migracji międzynarodowych. „Prace geograficzne” IGiPZ PAN, Nr 181.

³⁷ Kupiszewski, (1996). In: European Union, (Ed.) P. Rees, J. Stillwell, A. Convey, M. Kupiszewski, John Wiley and Sons, Chichester, 13–38.

³⁸ Wiśniowski, A. (2016). Combining Labour Force Survey Data to Estimate Migration Flows: The Case of Migration from Poland to the UK. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, Version of Record online: 10 MAR 2016, DOI: 10.1111/rssa.12189

3. Methodology and Data

This paper uses the ‘Labour Force Survey’ (LFS) data, collected by the UK government (ONS, 2015; and earlier LFS surveys³⁹). The data refers to the 5 regions of the UK with the highest fraction of people who are born in Poland. They are: Yorks/Hum (Yorkshire/Humberside), East Anglia, Greater London (referred to in this paper as London), North-West England, and Scotland. Monthly data from 2003 to 2014 is analysed.

The LFS data used in this paper is based on interviews which were carried out (by the UK government) on Sundays. An analysis by the authors (not included in this paper) suggests that interviewing on Sundays may affect the results, because many Poles appear to return to Poland during school holidays to visit relatives, and they may choose to travel on Sundays (and hence not be at home when interviewers visit their UK home). It is not clear if this affects the results in this paper; despite such complications, the authors consider the LFS to be the best data source for this paper, because the LFS has very large sample-sizes.

Table 1 shows the basic distribution parameters of the percentage of Poles living in the UK; the distributions are illustrated by the box plots in Figure 1.

Table 1. Summary Statistics for the Fraction of Residents Who Are Polish-Born, in UK Regions

<i>UK Region</i>	<i>Mean</i>	<i>S.D.</i>	<i>V</i>	<i>Asymmetry</i>
Yorks/Hum	0.0061	0.0035	0.57	0.10
East Anglia	0.0067	0.0044	0.66	0.30
London	0.0119	0.0047	0.40	0.08
North-West	0.0050	0.0037	0.75	1.06
Scotland	0.0064	0.0048	0.75	0.20

Source: The authors’ analysis of LFS data.

The highest average value of the fraction of Poles (0.0119) is in London, and the highest variability is in North-West England and Scotland (for which the co-efficient of variation was 0.75). Distributions of Poles are right-side asymmetrical, with low or moderate strength asymmetry power with the exception

³⁹ ONS (2015). *Quarterly Labour Force Survey, October – December, 2014 [data collection]*. UK Data Service. SN: 7664, <http://dx.doi.org/10.5255/UKDA-SN-7664-1>. Office for National Statistics.

of North-West region, for which the asymmetry co-efficient indicates a strong right-sided asymmetry.

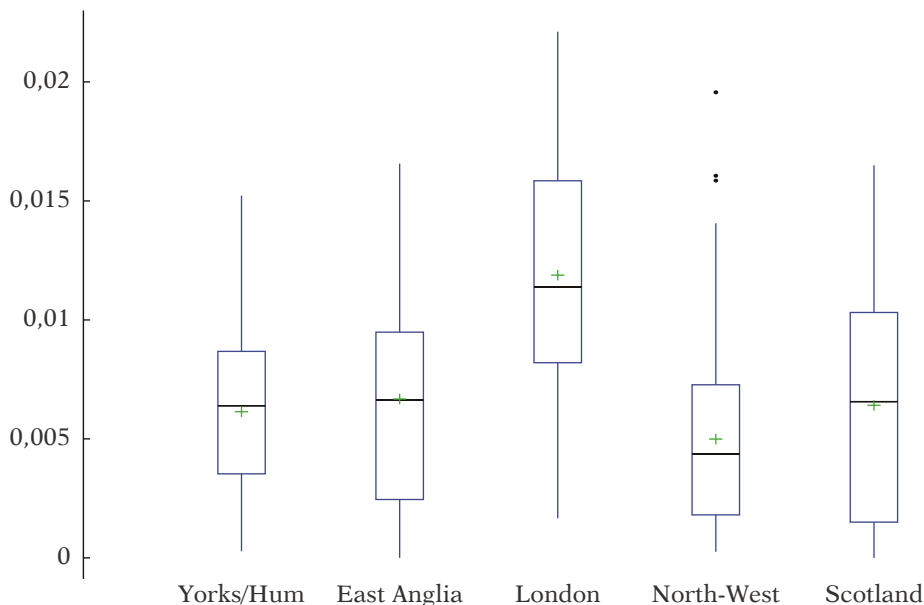


Figure 1. Box Plots for Polish Fractions in UK Regions

Source: The authors' analysis of LFS data.

A graphical analysis of the time-series data on the fraction of Poles living in different regions of the UK is shown in Figure 2.

Figure 2 indicates that one of the appropriate ways of modelling this fraction are unconditional econometric models based on the trend, seasonality and autoregression. The equation of this model is as follows⁴⁰:

$$y_t = \sum_{j=0}^r \beta_j t^j + \sum_{i=0}^{l-1} d_i q_{ti} + \sum_{s=1}^p \rho_s y_{t-s} + \xi_t \quad (1)$$

where: y_t – fraction of Poles living in the UK region; q_{ti} – seasonal variables; β_j , d_i , ρ_s – structural parameters of the model; ξ_t – random variables. The polynomial trend degree is chosen based on the residual variance ratio test. The order of the autoregression was determined on the statistical significance of the

⁴⁰ Kufel, T. (2004). *Ekonometria. Rozwiązywanie problemów z wykorzystaniem programu GRETL*. PWN, Warszawa.

partial autocorrelation co-efficients for the residual process (PACF). The Que-nouille test was used, in which $H_0 : \rho_\tau = 0$, where τ is the time interval between residual processes⁴¹. In addition, the models in this paper include estimates for seasonal variation, following the *a posteriori* analysis.

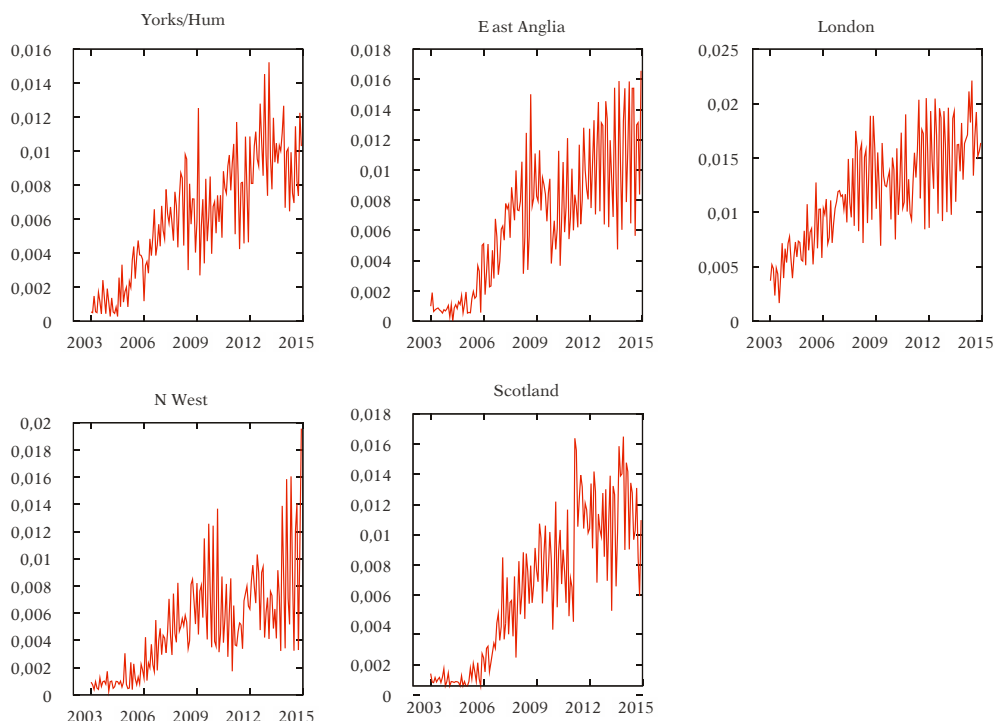


Figure 2. Time Series Plots of Polish People Living in UK Regions

Source: The authors' analysis of LFS data.

4. Results

To model the fraction of people living in various regions of the United Kingdom who are from Poland, unconditional econometric models are applied. These models were based on the trend, seasonality and autoregression. Tables 2–6 present estimates of the trend – seasonal – autoregression models for the fraction of

⁴¹ Osińska, M. (2007). (Ed.), *Ekonometria współczesna*. TNOiK, Toruń.

Poles living in the 5 selected regions of the UK. Figures 3–7 present graphically the actual and theoretical values of the fraction who is Polish.

A time-series analysis of Polish people living in the UK indicates two waves of migration: the first one took place in 2004–2008, and the other in the period 2011–2014 (Fig. 2). This phenomenon is reflected in statistically significant co-efficients at the time variable, expressed by a linear or polynomial trend line. There was significant monthly seasonality in all the researched regions. The most common negative seasonality estimates occurred for January, while the most positive month is June. The analysis of residuals for trend-seasonal models point out the presence in all the models of third-order autoregression. The increase in the fraction of Poles in period $t-3$ causes an increase in the current fraction on average of 0.60 in London, to 0.83 for North-West England. In other words, the fraction of Polish immigrants residing in the UK depends on the level of the fraction which took place three months earlier.

The models applied in this paper include only statistically significant autoregression co-efficients. The results also show significant autoregression of order 1, 2, 6 and 12, respectively, in these particular models.

Table 2. OLS Estimates of Trend-sSasonal-Autoregression Model for Yorks/Hum Region

<i>Variable</i>	<i>Co-efficient</i>	<i>t-ratio</i>	<i>p</i>
const	-0.00011	-0.246	0.806
Jan	-0.00071	-1.930	0.056
Feb	0.00086	2.330	0.021
time	6.08×10^{-5}	3.590	0.001
time ²	-1.83×10^{-7}	-1.947	0.054
BirthPol(-3)	0.71741	8.416	0.000
BirthPol(-6)	-0.20045	-2.326	0.022
$R^2 = 0.813$; $DW = 2.29$ 1; $S_{\xi} = 0.0015$; $\chi^2(2) = 1.803[0.405]$; $F(12;119) = 1.041[0.416]$			
Note: S_{ξ} denotes standard error of residuals, $\chi^2(2)$ denotes statistics of Doornik-Hansen test for normality of residuals, DW, F denotes respectively statistics of Durbin-Watson and Breusch-Godfrey test for autocorrelation of residuals.			

Source: The authors' analysis of LFS data.

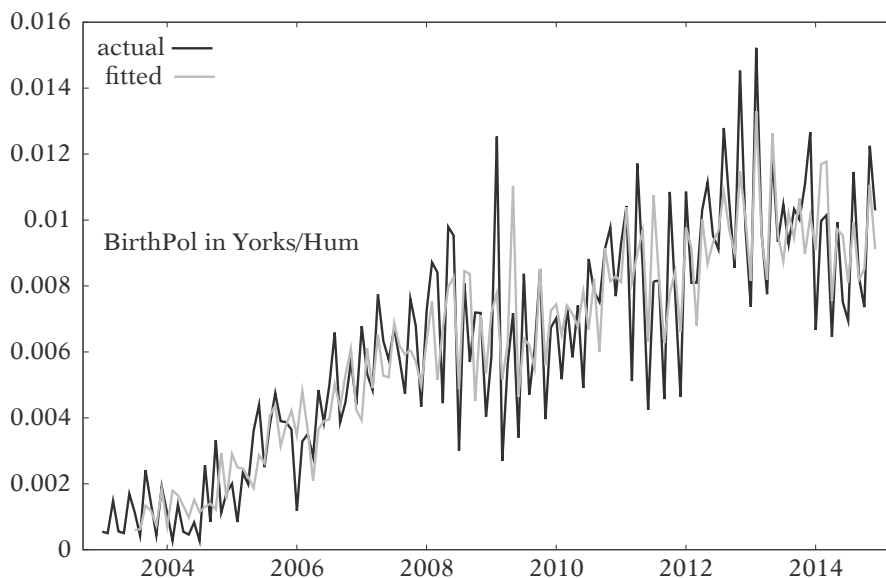


Figure 3. Actual and Fitted Values of Polish Fractions in Yorks/Hum Region

Source: The authors' analysis of LFS data.

Table 3. OLS Estimates of Trend-Seasonal-Autoregression Model for East Anglia Region

<i>Variable</i>	<i>Co-efficient</i>	<i>t-ratio</i>	<i>p</i>
const	0.00025	0.837	0.404
May	-0.00078	-1.790	0.076
Jun	0.00096	2.272	0.025
Sep	0.00073	1.717	0.088
time	2.11×10^{-5}	3.534	0.001
BirthPol(-3)	0.760604	13.332	0.000

$R^2 = 0.858$; $DW = 2.053$; $S_{\xi} = 0.0017$;
 $\chi^2(2) = 1.179[0.554]$; $F(12;123) = 0.414[0.955]$

Note: S_{ξ} denotes standard error of residuals, $\chi^2(2)$ denotes statistics of Doornik-Hansen test for normality of residuals, DW, F denotes respectively statistics of Durbin-Watson and Breusch-Godfrey test for autocorrelation of residuals.

Source: The authors' analysis of LFS data.

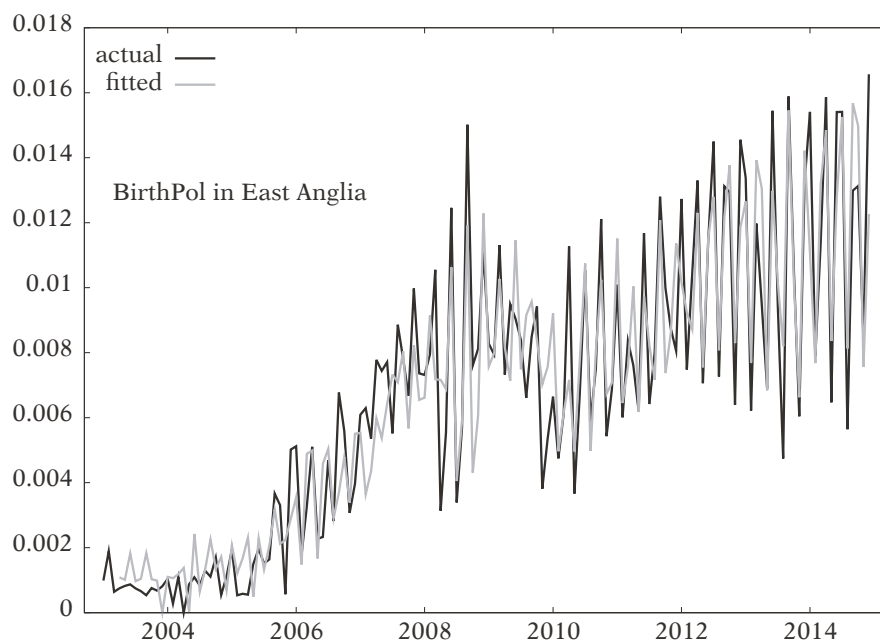


Figure 4. Actual and Fitted Values of Polish Fractions in East Anglia Region

Source: The authors' analysis of LFS data.

Table 4. OLS Estimates of Trend-Seasonal-Autoregression Model for London

<i>Variable</i>	<i>Co-efficient</i>	<i>t-Student</i>	<i>p</i>
const	0.00258	4.841	0.000
Apr	-0.00104	-1.734	0.085
Jun	0.00197	3.328	0.001
Jul	-0.00129	-2.139	0.034
Nov	0.00139	2.341	0.021
time	3.15×10^{-5}	4.256	0.000
BirthPol(-3)	0.60378	9.212	0.000
$R^2 = 0.770$; $DW = 2.147$; $S_{\xi} = 0.0023$; $\chi^2(2) = 0.332[0.847]$; $F(12;122) = 1.626[0.092]$			
Note: S_{ξ} denotes standard error of residuals, $\chi^2(2)$ denotes statistics of Doornik-Hansen test for normality of residuals, DW, F denotes respectively statistics of Durbin-Watson and Breusch-Godfrey test for autocorrelation of residuals.			

Source: The authors' analysis of LFS data.

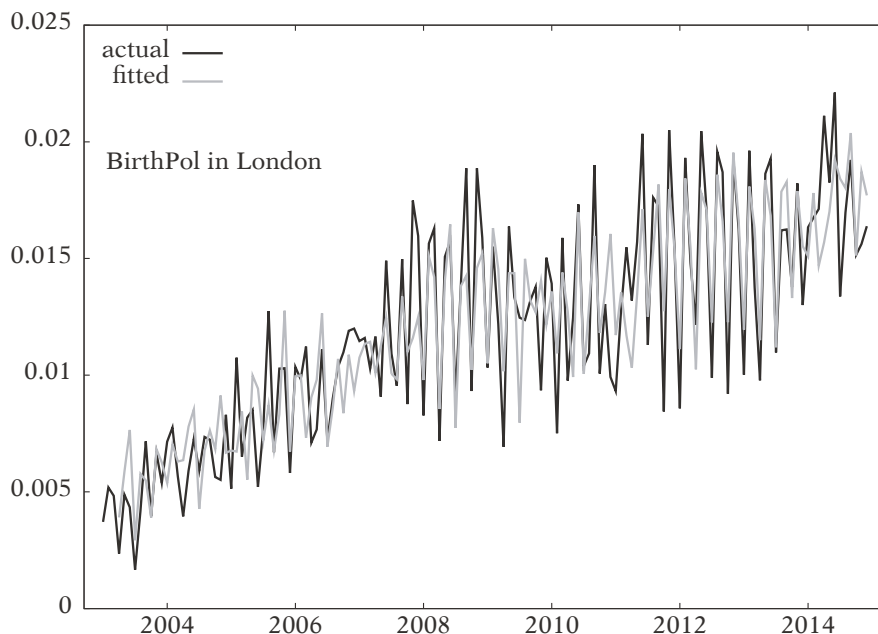


Figure 5. Actual and Fitted Values of Polish Fractions in London

Source: The authors' analysis of LFS data.

Table 5. OLS Estimations of Trend-Seasonal-Autoregression Model for North-West England

Variable	Co-efficient	t-Student	p
const	0.00013	0.387	0.699
Jan	-0.00124	-2.611	0.010
Jun	0.00082	1.735	0.085
Jul	-0.00107	-2.244	0.027
Aug	-0.00128	-2.680	0.008
Sep	0.00122	2.554	0.012
Nov	0.00091	1.935	0.055
time	2.71×10^{-5}	4.278	0.000
BirthPol(-3)	0.83072	13.270	0.000
BirthPol(-12)	-0.25601	-3.459	0.000

$$R^2 = 0.835; DW = 2.046; S_{\xi} = 0.0016; \chi^2(2) = 0.095[0.953]; F(12;105) = 0.742[0.707]$$

Note: S_{ξ} denotes standard error of residuals, $\chi^2(2)$ denotes statistics of Doornik-Hansen test for normality of residuals, DW, F denotes respectively statistics of Durbin-Watson and Breusch-Godfrey test for to correlation of residuals.

Source: The authors' analysis of LFS data.

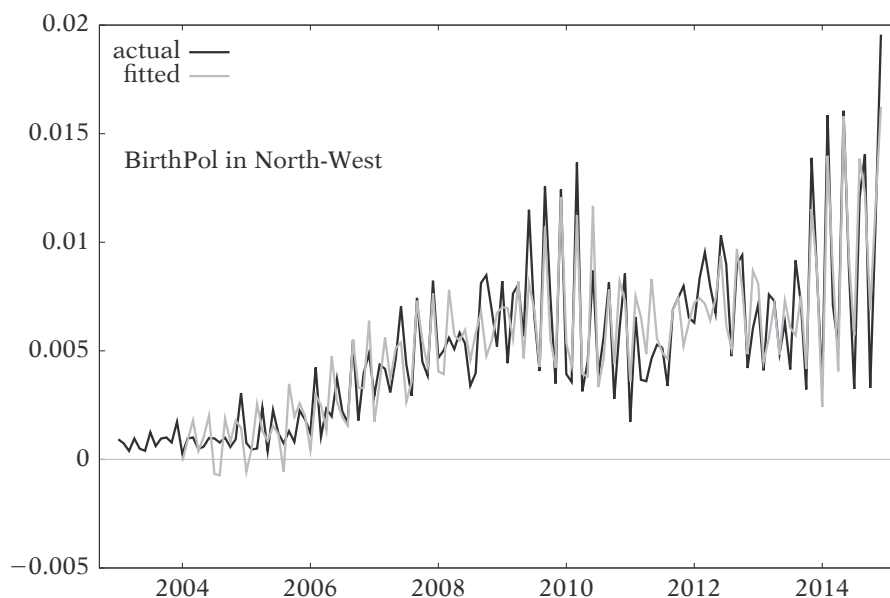


Figure 6. Actual and Fitted Values of Polish Fractions in North-West England

Source: The authors' analysis of LFS data.

Table 6. OLS Estimations of Trend-Seasonal-Autoregression Model for Scotland, UK Region

<i>Variable</i>	<i>Co-efficient</i>	<i>t-Student</i>	<i>p</i>
const	-0.00023	-0.648	0.518
Jan	-0.00111	-2.474	0.015
Apr	0.00082	1.789	0.076
time	4.20×10^{-5}	4.553	0.000
s1(03.2011)	0.00824	4.530	0.000
s2(04.2011)	0.00811	4.302	0.000
BirthPol(-3)	0.72864	9.083	0.000
BirthPol(-6)	-0.18041	-2.219	0.028

$R^2 = 0.864$; $DW = 1.891$; $S_{\xi} = 0.0018$;
 $\chi^2(2) = 3,414[0.181]$; $F(12;118) = 0.568[0.864]$

Note: S_{ξ} denotes standard error of residuals, $\chi^2(2)$ denotes statistics of Doornik-Hansen test for normality of residuals, DW , F denotes respectively statistics of Durbin-Watson and Breusch-Godfrey test for autocorrelation of residuals, $S1$, $S2$ denote dummy variables in points (03.2011) and (04.2011) for an outliers observation.

Source: The authors' analysis of LFS data.

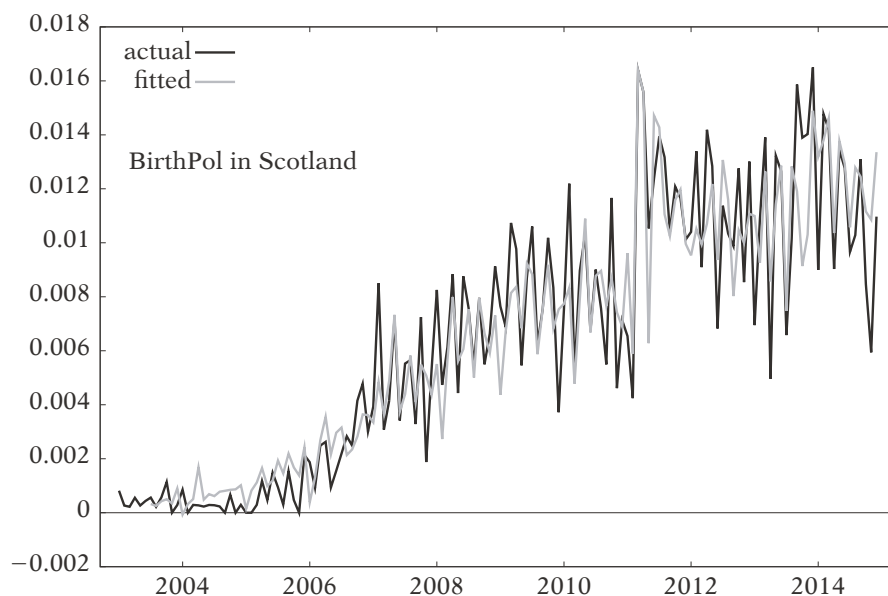


Figure 7. Actual and Fitted Values of Polish Fractions in Scotland

Source: The authors' analysis of LFS data.

In Table 6, the R^2 value is high (0.86): our regression explains 86% of the variation of Poles in Scotland. The success of the regression is confirmed in Figure 7: the blue line (fitted values from our regression) is very similar to the red line (the actual fraction of the Scottish residents who were born in Poland). Similarly for London: our regression explains 77% of the variation of the Polish-born people who live in London. However, the co-efficient of random variation ($V_{\xi} = S_{\xi} / \bar{y}$) excess of 0.2 constrains the estimated models to the historical interpretation. These models are not allowed to achieve acceptable results regarding forecasts. The results of the diagnostic tests for all the models indicate that the stochastic assumptions regarding the normality of residuals (Doornik – Hansen test) and homoscedasticity (White test) cannot be rejected (Maddala, 2004): these test statistics are below their critical values.

5. Conclusion

The paper presents a statistical and econometric analysis of the fraction of Poles living in the selected regions of the UK. London was the region with

most Polish-born residents: it has a linear growth in the fraction of Poles, in the period we studied. In other UK regions, the Polish-born fractions were similar, and their growth occurred in two stages: up to 2008, and after 2011. The models we applied confirm the presence of linear and non-linear trends. Systematic factors in the form of seasonal variations were isolated, too: estimates indicate a significantly higher or lower deviation from the average level, in particular months. The most frequently statistically significant seasonality was observed for January: it was negative, and appeared in Yorkshire/Humberside, North-West England, and Scotland. There was also a significant negative seasonality in July, caused by the return to Poland for holiday activities: this occurred in North-West England and London. Positive significant seasonal variations were observed for June in the regions of East Anglia, London, and North-West England. We observe autoregressive components in the fraction of Poles, mainly for three-month and six-month lags. The regression models we present describe variations in the Polish fraction of UK residents, and they allow us to assess trends in the emigration of Poles to the UK.

References

- Anacka, M., Brzozowski, J., Chałupczak, H., Fihel, A., Firlit-Fesnak, G., Garapich, M., Grabowska-Lusińska, I., Heffner, K., Jaźwińska, E., Jończy, R., Kaczmarczyk, P., Krzyżowski, Ł., Lesińska, M., Okólski, M., Prasałowicz, D., Rauziński, R., Rokita-Poskart, D., Slany, K., Solga, B., Ślusarczyk, M. & Urbańska, S. (2014). *Společné skutki poakcesyjnych migracji ludności polski: raport komitetu badań nad migracjami polskiej akademii nauk*. Warszawa.
- Arango, J. (2000). Explaining Migration: A Critical View. *International Social Science Journal* 52(165), 283–296.
- Bodvarsson, Ö.B. & Van den Berg, H. (2013). *The Determinants of International Migration: Theory*. Chapter 2, in: *The Economics of Immigration: Theory and Policy*, DOI 10.1007/978-1-4614-2116-0_2, Springer Science + Business Media, New York.
- Espíndola, A.L., Silveira, J.J. & Penna, T.J.P. (2006). A Harris-Todaro Agent-Based Model to Rural-Urban Migration. *Brazilian Journal of Physics* 36 (3a), 603–608.
- Fihel, A. & Piętka, E. (2007). *Funkcjonowanie polskich migrantów na brytyjskim rynku pracy*. Formerly ISS WORKING PAPERS, seria: PRACE MIGRACYJNE, No 23/81, Centre of Migration Research, Faculty of Economic Sciences, Warsaw University.
- Government Population Council (2011). *Sytuacja demograficzna Polski. Raport 2010–2011 [Demographic Situation of Poland, 2010–2011 Report]*. Warszawa.

- Greenwood, M.J. (2005) *Modeling Migration*. Encyclopedia of Social Measurement Volume 2, (Ed.) K. Kempf-Leonard, Elsevier, Amsterdam, 725–34.
- Hannerberg, D. & Hägerstrand, T., eds. (1957). *Migration in Sweden: A Symposium*. Lund Studies in Geography: Series B, *Human Geography*, 13,. CWK Gleerup, Lund.
- Kufel, T. (2004). *Ekonometria. Rozwiązywanie problemów z wykorzystaniem programu GRET*. PWN, Warszawa.
- Kupiszewski, M. (1996). In: *European Union*. (Ed.) P. Rees, J. Stillwell, A. Convey, M. Kupiszewski, John Wiley and Sons, Chichester.
- Kupiszewski, M. (2001). *Demograficzne aspekty wybranych prognoz migracji zagranicznych, [w:] Swobodny przepływ pracowników w kontekście wejścia Polski do Unii Europejskiej*. (Ed.) A. Stępnia, UKiE.
- Kupiszewski, M., 2002. Modelowanie dynamiki przemian ludności w warunkach wzrostu znaczenia migracji międzynarodowych. „*Prace geograficzne*” IGiPZ PAN, Nr 181.
- Kupiszewski, M. (Ed.) (2013). *International Migration and the Future of Populations and Labour in Europe*, The Springer Series on Demographic Methods and Population Analysis.
- Kurekova, L. (2011). *Theories of Migration: A Conceptual Review and Empirical Testing in the Context of the EU East-West Flows*. Paper prepared for the Interdisciplinary Conference on Migration. Economic Change, Social Challenge. 6th to 9th April 2011, University College London, UK.
- Łobacz, K., Klimek, J., Majchrzak, M. & Niedzielski, P. (2012). *Migranci na rynku pracy w wybranych krajach Europy: wsparcie formalno-prawne i organizacyjne [Migrants on the Labour Market within Selected European Countries: The Legal Context and Organisational Support]*. European Migrant Adviser Toolkit.
- Maddala, G.S. (2006). *Ekonometria*. PWN, Warszawa.
- Okólski, M. (2005). *Demografia. Podstawowe pojęcia, procesy i teorie w encyklopedycznym zarysie*. Wyd. Naukowe Scholar, Warszawa.
- ONS (2015). *Quarterly Labour Force Survey, October – December, 2014 [data collection]*. UK Data Service. SN: 7664, <http://dx.doi.org/10.5255/UKDA-SN-7664-1>. Office for National Statistics.
- Organiściak-Krzykowska, A. (2013). *Contemporary Conditions and Directions of Migration in Poland: Returns from Migrating to the Annual Operating on the Market Situation to Poland*. UWM Publishing, Olsztyn.
- Organiściak-Krzykowska, A. & Machnis-Walasek, J. (2014). *Edukacyjne uwarunkowania powrotów Polaków z emigracji zarobkowej*. Acta Universitatis Lodzianensis. Folia Oeconomica.
- Organiściak-Krzykowska, A. (2015). *Reasons for and Directions in Poles' Temporary Migrations*. PowerPoint presentation: University of Warmia and Mazury in Olsztyn, Poland.
- Osińska, M. (2007). (Ed.), *Ekonometria współczesna*. TNOiK, Toruń.

Wiśniowski, A. (2016). Combining Labour Force Survey Data to Estimate Migration Flows: The Case of Migration from Poland to the UK. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, Version of Record online: 10 MAR 2016, DOI: 10.1111/rssa.12189

Online Reference Sources

<http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-235204>

<http://www.migrationwatchuk.org/briefing-paper/257>

* * *

Polska migracja do Wielkiej Brytanii – ekonometryczne modele trendu i sezonowości

Streszczenie

Celem badań jest budowa i statystyczna weryfikacja modeli trendu oraz sezonowości opisujących odsetek Polaków zamieszkujących wybrane regiony Wielkiej Brytanii. Zastosowano bezwarunkowe modele ekonometryczne opierające się na trendzie, sezonowości i autoregresji. Oszacowano parametry modeli trendowo-sezonowo-autoregresyjnych dla odsetka Polaków mieszkających w pięciu wybranych regionach Wielkiej Brytanii. Analiza szeregów czasowych tego odsetka pozwala zauważyć dwie fale migracji: pierwsza miała miejsce w latach 2004–2008, a druga w okresie 2011–2014. Zjawisko to ma swoje odzwierciedlenie w statystycznie istotnych współczynnikach przy zmiennej czasowej wyrażonej trendem liniowym lub wielomianowym. We wszystkich badanych regionach miała miejsce istotna sezonowość miesięczna. W większości regionów występują ujemne współczynniki sezonowości dla stycznia, natomiast dodatnie dla czerwca. Analiza procesu resztowego modeli trendowo-sezonowych wskazała na występowanie autokorelacji trzeciego rzędu.

Słowa kluczowe: migracja, Polacy w Wielkiej Brytanii, sezonowość

