ESTIMATION OF FLEXICURITY LEVEL IN EU/EEA COUNTRIES USING THE FUZZY LOGIC APPROACH

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Abstract

European Commission has defined four principles that characterize the overall labour market flexicurity: (a) flexible contractual arrangement; (b) comprehensive lifelong learning strategies; (c) effective active labour market policies; and (d) modern social security system. So far, there is no single flexicurity indicator created that integrates all fours flexicurity principles. Fuzzy Logic Approach is a strong mathematical tool for estimating results that are based on vaguely criteria. It is used for measuring the project effectiveness (Ray S. et al., 2012), creating project portfolio in public administration (Nassif N. L. et al., 2013) and others. The aim is to test the adequacy of Fuzzy Logic Approach to form a single measurement of flexicurity implementation among EU/EEA countries. The outcome of the study approves the adequacy of Fuzzy Logic Approach usage for flexicurity estimation, and provides reader with comparative analysis on flexicurity implementation across EU/EEA countries for the period from 2006 to 2012. Results suggest that countries with "good" flexicurity performance are Denmark, the Netherlands, Finland, Sweden, and Norway, but "poor" implementation of flexicurity - Bulgaria, Romania, Greece, Italy, Malta. Results are not contrary to other studies.

Key words: flexicurity, fuzzy logic, EU, EEA

JEL Code: J08, C63, P52

Introduction

Labour-market flexicurity is a relatively new concept, introduced in Europe at the end of 20th century. Later through the revision of the Lisbon Strategy at 2005, the flexicurity principle was first encouraged by the Integrated Guideline No.21: "Promote flexibility combined with employment security and reduce labour market segmentation, having due regard to the role of the social partners". Four principles characterize the overall flexicurity concept; they have been defined by European Commission at 2007: (a) flexible and reliable contractual arrangement through modern labour laws, collective agreements and work organisation; (b) comprehensive lifelong learning strategies; (c) effective active labour market policies; and (d)

modern social security system that provides adequate income support and encourages employment, and facilitates labour market mobility.

Since flexicurity concept and its principles are defined on the European level, still there is no common measurement developed to estimate the flexicurity in the labour market. Factor and cluster analysis are used to group variables or countries by their similarities (European Foundation for the Improvement of Living and Working Conditions (here and after Eurofound), 2007), however, it does not answer to the question about the overall flexicurity level within country. New ways of quantifying the labour market achievements by countries must be introduced. Furthermore, the perception of what is the flexicurity and what is a good level of it also differs across EU/EEA. These disparities originate from cultural, historical, national and other background. Fuzzy Logic Approach allows incorporating vague criteria into the analysis, therefore is a promising way of estimating the overall flexicurity level.

The target of the research is to develop and test a new methodology of flexicurity estimation based on Fuzzy Logic Approach. As a result, the level of flexicurity of the labour market in particular country is found to be "good" in Denmark, the Netherlands, Finland, Sweden, and Norway, but "poor" level of flexicurity is in Bulgaria, Romania, Greece, Italy, and Malta. This is in accordance with other researches, where different methodologies, as for example, cluster analysis, are used.

The paper is organised as follow – in the first section literature review is given about the flexicurity implementation in EU/EEA countries. In the second section the methodology and data are described. The third section gives the final estimation of the flexicurity level in EU/EEA countries by using the newly developed Fuzzy Logic Approach. The paper is finished with the conclusion.

1 Literature Review

The flexicurity as an economic policy was developed in 1980s with the Netherlands and Denmark as two benchmark countries of the concept implementation. The changes in economics were towards growing flexibility of employment relations with lower security and social benefits, which was not well supported approach especially by countries as France and Germany (Tangian, 2008). In 1995 the Dutch Scientific Council of Government Policy, Professor Hans Adriaansens introduced idea about the shift from job security toward employment security. The improvements in employment opportunities became more

important. By now it is understood as increasing quality and availability of lifelong learning and active labour market policy, as well as contracts with collective trade / labour unions.

At the same time literature suggests that the social security (unemployment benefits particularly) may be a substitute for employment protection legislation (EPL). The function of the both is to protect the worker against risk to lose income. Boeri et al. (2012) analysis the trade-off by displaying the index of the strictness of employment protection and the expenditure on unemployment benefits, and finds an inverse relationship. They also find that expenditure on unemployment benefits correlates with expenditure on active labour market policy (ALMP), therefore, similar trade-off is also between ALMP and EPL. By analysing the trade-off between job insecurity and transition rates from bad to good jobs, it is found that Ireland, the Netherlands and Denmark combine job security with high transition rates, while United Kingdom has both high level of insecurity and significant mobility (Boyer, 2006).

Boyer (2006) explains that neither total insecurity nor complete security is good for long-term growth. Therefore the target is to find an optimal level of different forms of securities, depending on other parameters by the country. This also does not mean that the flexibility should be maximized with reducing the security to the basic or minimum level. The main goal is to contribute to macroeconomic performance – increase in employment, gross domestic product etc. As it is found by Dolenc and Laporsek (2013) active labour market policies and participation in lifelong learning programs do increase the labour and total factor productivity growth, while productivity growth is negatively related to rigid employment protection and high expenditures for passive labour market policies.

When applying the cluster analysis, the Eurofond (2007) distribute all EU countries in 6 groups:

(1) Old EU Member States – Austria, Belgium, France, Germany and Luxembourg – represent a continental model where social protection is relatively high and the labour market is rigid with low mobility;
(2) The Netherlands and the UK represent fairly liberal and flexible labour markets;
(3) Denmark, Finland and Sweden represent benchmarking models;
(4) Baltic States, Ireland and Cyprus represent flexible labour markets with the lowest social protection in the EU;
(5) Greece, Italy, Malta, Portugal and Spain represent southern Europe with low labour market adaptability and income protection;

(6) New Member States (NMS) from central Europe – Czech Republic, Hungary, Poland, Slovakia and Slovenia – represent labour market with relatively low mobility.

Countries could be also distributed in four groups by their level (high or low) of employment protection and social protection. This was done by Boyer (2006) and the results suggest that during the late 1990s and early 2000s: (a) High employment protection and high social protection was in France, Germany, and Sweden; (b) Low employment protection and high social protection was in Denmark, Belgium, the Netherlands, Finland, and Ireland. This correspond partly to previously described trade-off, when labour market rigidness is reduced by improving the social and employment security (Boeri, et al., 2012); (c) High employment protection but low social protection was in Portugal, Greece, and Italy; (d) Low employment protection and low social protection was in United Kingdom and United States.

The trade-off between social security and employment flexicurity is no longer obvious and all preconditions for introducing flexicurity are there. While previously mentioned techniques of analysis help understand weaknesses of each country on implementing the flexicurity and gives information how countries deal with trade-off between flexibility and security, these approaches do not get estimates of the overall level of flexicurity.

2 Methodology

The classical mathematics is based on the assumption of bivalence – either the statement is true or false, while the Fuzzy logic allows for subset of values in between. The Fuzzy subset is the set of $X \rightarrow [0, 1]$ describing the real situation (Lebedinska, 2010, 6 p.). The Fuzzy set theory was introduced by American mathematician and engineer Lotfi Zadeh in 1965, when he first described the Fuzzy sets in solving mathematical management problems (Zadeh, 1965). When applying Fuzzy Logic Approach to estimate the level of flexicurity, following steps are taken: (a) select quantitative variables describing the flexicurity in the labour market; (b) define linguistic variables and their levels for each of the previously chosen quantitative variables; (c) define Fuzzy numbers and calculate the Fuzzy measurement indexes (FMIs) for each country under assumptions of linguistic levels; (d) match the FMIs with pre-defined linguistic levels of the total flexicurity in the labour market by using the Euclidian distance measure. Developed methodology is based on the Fuzzy Logic Approach used for estimating the project effectiveness (Ray et al., 2013).

1.1 Data

In 2007 in the European Commission paper "Towards Common Principles of Flexicurity: More and better jobs through flexibility and security" indicators for describing the four flexicurity principles were defined in the Annex III "Background indicators relevant for flexicurity". This list has been a base for the further choice of quantitative data used in the analysis. Data for years 2006, 2008, 2010 and 2012 are used to follow the dynamics.

Tab. 1: Quantitative Variables Used for the Flexicurity Estimation

1. FLEXIBLE CONTRACTUAL ARRANGEMENTS	GCI - Hiring and firing practices
	EUROSTAT - Temporary employment
	EUROSTAT - Part-time employment
	EUROSTAT- Involuntary Part-time employment
	GCI - Cooperation in labour-employer relations
2. COMPREHENSIVE LIFE-LONG LEARNING STRATEGIES	EUROSTAT - Participation rate in lifelong learning(LLL)
	EUROSTAT - Population (age 25 - 34) with at least upper secondary education
	EUROSTAT - Population (age 45 - 54) with at least upper secondary education
	GCI - On the job training
3. EFFECTIVE ACTIVE LABOUR MARKET POLICIES	EUROSTAT-Labour market expenditure on active LMP (% of GDP)
	EUROSTAT-Labour market expenditure on pasive LMP (% of GDP)
	EUROSTAT - Labour market expenditure on active LMP (share of total expenditure on LMP)
	EUROSTAT - Share of Labour market participants in active LMP
4. MODERN SOCIAL SECURITY SYSTEMS	OECD - Net Replacement ratios (67% of Average Wage for single person with no children)
	OECD - Transition into full-time work from unemployment with initial unemployment benefit (single person with no children, 67% of Average Wage)
5. LABOUR MARKET OUTCOMES	EUROSTAT - Total employment rate
	EUROSTAT- Long-term unemployment rate
	EUROSTAT - Labour productivity, euro per hour worked
	EUROSTAT - At-risk-of-poverty rate (cut-off point: 60% of median equivalised income after social transfers)

Source: authors' choice on quantitative data used for the analysis

1.2 Fuzzy Logic Approach

Five linguistic variables were defined: "very poor", "poor", "fair", "good", and "very good". The corresponding values for re-defining quantitative data to linguistic data are defined under the laws of normal distribution:

(a) Quantitative variable has a linguistic level of "fair" within the distance of 0.5 standard deviations around the average level of the variable among all countries;

(b) Quantitative variable has a linguistic level of "poor" if it is 1.5 to 0.5 standard deviations below the average level of all countries and a level of "good" if the same distance above the average level;

(c) Quantitative variable has a linguistic level of "very poor" if it is more than 1.5 standard deviations below the average level of all countries and a level of "very good" if it is more than 1.5 standard deviations above the average level.

The Fuzzy numbers can be indicated in the range from 0 to 1, or 0 to 10, or 0 to 100 or other, where 0 is absolute falsity and the maximum value is absolute truth. In the estimation of flexicurity level in EU/EEA countries, the absolute falsity applies for "no flexicurity" in the labour market but absolute truth is "full flexicurity". In between the overall level of flexicurity is described by using also five linguistic variables. The Fuzzy numbers for linguistic variables are given in the Table 2. Fuzzy numbers are defined under the triangle membership function – with the lower (I1), most likely (I2), and upper (I3) performance rating values.

Tab. 2: Triangle Membership Function for Linguistic Variables

Linguistic Variable	Abbreviation	I1	I2	I3
Very poor	W	0.0	1.0	3.0
Poor	P	2.0	3.0	5.0
Fair	F	4.0	5.0	7.0
Good	G	6.0	7.0	9.0
Very good	B	8.0	9.0	10.0

Source: authors' assumption on the form of Fuzzy Membership Function for linguistic variables

Very important characteristic of Fuzzy logic is that the intervals of linguistic variables are allowed to overlap, because there is no perfect break point between them. If we assume that poor flexicurity is described by interval 2 to 5 in the Fuzzy subset [0, 10], we cannot affirm, that value greater by one point (5,1) is no longer poor level of flexicurity or by one point lower (4,9) is not already a fair level of flexicurity. The Fuzzy Measurement Indexes (FMIs) are calculated as the average from all Fuzzy numbers of variables for each country separately, for each of three assumptions (I1, I2 and I3). The final flexicurity level is found by using the Euclidian distance (Formula 1) – the smallest difference between countries' actually found three FMIs and three Fuzzy numbers of every linguistic level.

$$E_{distance}(FMI,\text{Linguistic variable}) = \sqrt{(FMI(1)-I1_i)^2 + (FMI(2)-I2_i)^2 + (FMI(3)-I3_i)^2}\ , \qquad (1)$$

where FMI (N) – three Fuzzy numbers of certain linguistic level corresponding to actual data, and $I(N)_i$ – three Fuzzy numbers corresponding to linguistic level i defined in Table 2, N={1,2,3}.

3 The Flexicurity Level in EU/EEA Countries

The flexicurity level has been estimated for the EU/EEA countries by using previously described technique under four different scenarios to introduce the stability analysis of the methodology applied (summary in Table 3). Scenarios are following:

Scenario (1): Including the 5th principle "Labour market outcomes", without weighting;

Scenario (2): Including the 5th principle "Labour market outcomes", with weighting (20% for each principle, equally divided among variables within principle);

Scenario (3): Excluding the 5th principle "Labour market outcomes", without weighting;

Scenario (4): Excluding the 5th principle "Labour market outcomes", with weighting (25% for each principle, equally divided among variables within principle).

In most of the times all four scenarios give the same results of the flexicurity level within each country, with following exceptions:

- In all years the Scenario (4) gives worse estimate of flexicurity in Bulgaria and United Kingdom;
- In 2006 the Scenario (1) gives better estimate of flexicurity in Austria but in 2008 the Scenario (1) gives worse estimate of flexicurity in Estonia;
- In 2008 and 2012 the Scenario (2) gives worse estimate of flexicurity in Slovakia;
- In 2012 the flexicurity estimate improves in Luxembourg when weighting in analysis is not introduced – the Scenario (3);
- Under the Scenarios (3) and (4) the flexicurity estimate improves in Cyprus but worsens in Norway.

The method applied estimates the flexicurity level in all EU/EEA countries as "poor", "fair" or "good", no extremes are observed ("very poor" or "very good"). This can be explained by understanding that there is no country in EU/EEA which has not implemented any economic policy towards more flexible and secure labour market; therefore, the performance level should be higher than "very poor" level. At the same time as the flexicurity concept is relatively new, no of the countries have been able to implement the best practice fully, therefore the level of "very good" flexicurity is not reached yet. Never though, in our interest is to divide all EU/EEA countries in as many levels of flexicurity as possible, therefore the

implications of the Fuzzy Logic Approach and initial parameters in estimating the flexicurity need further investigation.

Results suggest that countries with "good" flexicurity performance are Denmark, the Netherlands, Finland, Sweden, and Norway, but "poor" implementation of flexicurity is in Bulgaria, Romania, Greece, Italy, and Malta and that is not in contrary to other studies as discussed in the first section of the paper. At the same time no strong dynamics are observed.

Tab. 3: The Stability Analysis of the Level of Flexicurity in the EU/EEA Countries

	2006				2008				2010				2012			
Scenario	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Belgium	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Bulgaria	-	-	-	-	P	P	P	F	P	P	P	F	P	P	P	F
Czech Rep.	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Denmark	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Germany	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Estonia	F	F	F	F	F	P	P	P	F	F	F	F	F	F	F	F
Ireland	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Greece	P	P	P	P	P	P	P	P	P	P	P	P	-	-	-	-
Spain	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
France	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Italy	P	F	F	F	F	F	F	F	P	P	P	P	P	P	P	P
Cyprus	F	F	P	P	-	-	-	-	-	-	-	-	-	-	-	-
Latvia	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Lithuania	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Luxembourg	F	F	F	F	F	F	F	F	F	F	F	F	F	G	F	G
Hungary	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Malta	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Netherlands	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Austria	G	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Poland	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Portugal	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Romania	-	-	-	-	P	P	P	P	P	P	P	P	P	P	P	P
Slovenia	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Slovakia	F	F	F	F	F	P	F	F	F	F	F	F	F	P	F	F
Finland	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Sweden	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
UK	F	F	F	P	F	F	F	P	F	F	F	P	-	-	-	-
Norway	G	G	F	F	G	G	G	F	G	G	F	F	G	G	F	F

Source: authors' calculations based on EUROSTAT, OECD and GCI databases

Conclusion

The outcome of the study, firstly, approves the adequacy of Fuzzy Logic Approach usage for flexicurity estimation. There is more research needed to choose (a) better database for use in flexicurity analysis, (b) more precise linguistic variables and their levels around the mean, (c)better describing Fuzzy Membership Function. From the stability analysis done in this paper it is arguable that nor the weighting or inclusion of the fifth principle "Labour market outcome" has no major effect on estimation of flexicurity, which means that the methodology estimates stable results of the flexicurity levels by countries.

Secondly, the study provides a reader with comparative analysis and information on flexicurity implementation across EU/EEA countries for the period from 2006 to 2012. Results suggest that countries with "good" flexicurity performance are Denmark, the Netherlands, Finland, Sweden, and Norway, but "poor" implementation of flexicurity is in Bulgaria, Romania, Greece, Italy, and Malta and that is not in contrary to other studies. At the same time there are no strong changes in time for countries since 2006, which shows that economic policy for flexicurity improvements has not been introduced or has been weekly implemented. For Italy the flexicurity level has decreased over time. The flexicurity could be improved lately in Luxembourg - in 2012 in two out of four scenarios the flexicurity level has increased from "fair" to "good" level.

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