QUANTITATIVE METHODS IN ECONOMICS
Vol. XV, No. 2, 2014, pp. 47 - 63

OKUN'S LAW IN OECD COUNTRIES IN 1990 – 2013

Dariusz J. Błaszczuk
Department of Economics, Vistula University
e-mail: d.blaszczuk@vistula@edu.pl

Abstract: Politicians try to reach targets that usually contradict. It leads to lack of optimal long-term equilibrium.
The main target should be the maximal growth rate of GDP and other targets should remain within predetermined limits. Politicians should influence relations between every two targets.
Empirical study of relations between unemployment and GDP growth rates is done for every OECD country basing on quarterly data for 20 years. According to the results of the investigation countries are put into "strategic groups". Paper ends with preliminary proposals for economic policy makers.

Keywords: economic policy targets, long-term equilibrium, Okun's law, OECD countries, GDP growth rate, unemployment rate

INTRODUCTION

The aim of the overall macro-economic policy is to set a specific combination of individual targets. Depending on the situation in the economy in a given period there are, usually at the same time, for example: growth rate of GDP higher than a certain figure, level of the unemployment rate lower than a specified figure, inflation rate lower than a given value, assumed level of exchange rate, sustainability of public finances. They almost always are at least partly contradictory[1]. Striving to achieve them at the same time leads in a long run to political instability[2], especially in times of economic crises[3].

[1] Although for example, higher economic growth is generally associated with a lower level of unemployment, the two phenomena are accompanied by higher inflation and the stability of domestic prices usually interfere with the stability of the exchange rate.

[2] A classic example of such a situation was the collapse of the centrally planned economies, where the aim was to optimise the objectives of individual economic policies. Of course, the collapse was caused by the whole convolution of reasons and mentioned above was not the only important.

The solution of this problem is probably palpable intuitively by most of economic policymakers. It boils down to determine the maximum GDP growth rate that enables the fastest possible improvements in the standards of living of the citizens of the country[4] while maintaining the levels of other objectives within the predetermined limits. The way to achieve this objective is to make respective changes of the relationships within every pair of specified economic policy targets[5]. Therefore the relationships between every two specified targets of economic policy for the given economy should be earlier determined.

In the paper there are discussed the results of the empirical verification of the modified Okun's law, namely of the relationships between unemployment rates and the GDP growth rates[6]. There is, obviously, a large number of other empirical research studies directed at verification of the Okun's law[7]. The comparison of the received results with the figures provided by other authors is, however, somewhat difficult because of the different analytical forms of functions used in the respective studies. In general one can say, however, that in the presented study there is an expected sign of relationship between unemployment rate and GDP growth one only in case of 13 out of 33 analysed countries[8] and the slope varies from -1.3 to -0.1 (1% increase of unemployment rate causes decrease of GDP growth rate from 0.8% to 10.0%).

The results of the analysis are then used to build three maps of "strategic groups" of the analysed countries. Every map is based on two criteria: one associated with the level of unemployment and the second based on the levels of GDP. Analyses of these maps provide formulation of initial recommendations for economic policy makers of the relevant countries.

Further research will encompass empirical and theoretical long-term equilibrium points for individual countries and further recommendations for economic policy makers of the individual countries.

---

[3] Social unrests in Spain during the last economic crisis have been a striking example of such an instability.

[4] This statement is different from the one represented by eg. P. A. Samuelson and W. D. Nordhaus who claim that the respective aim should be the assumed level of inflation rate. See: Samuelson and Nordhaus (2004).

[5] For discussion of this issue see, for instance, Błaszczuk (2014a) and Błaszczuk (2014b).

[6] The relationship between the levels of inflation and unemployment rates virtually for the same group of countries and in virtually the same period have been presented to the IV Nationwide Scientific Conference in Poznan, Poland on April 25, 2014 [Błaszczuk D. J. (2014a)] and between rates of inflation and GDP growth rates, also for a similar group of countries and for a similar period, were presented to the III International Scientific Conference in Lodz, Poland on June 10, 2014 [Błaszczuk D. J. (2014b)].

[7] A comprehensive list of such studies is given, for instance, in R. Durech, A. Minea, L. T. Mustea, L. Slusna (2014).

[8] Expected and unexpected results have been also received by other authors, for instance, P. Klimczyk, G. Wronowska (2010).

ASSUMPTIONS OF THE INVESTIGATION, STATISTICAL DATA SOURCES AND RESEARCH METHOD

Assumptions apply to the subject, scope and period of the investigation. According to the statements given in the introduction, the subject of this research is the relationship between unemployment rates and the growth rates of GDP in selected countries. The research was assumed to cover all OECD countries in the period 1990Q1-2013Q4, so during the past two Juglar's business cycles.

Additionally, in order to obtain comparable results, it was assumed that the data on the harmonised unemployment rate (HUR) and the rate of GDP would be taken from the OECD statistical sources. However, data on the harmonized unemployment rate[9] for 13 countries[10] are available for shorter periods, and sometimes even much shorter ones than assumed above. Moreover, data on GDP growth rates[11] are not available for Greece and for 20 other countries[12] are available for shorter periods, sometimes much shorter from the assumed above. Unfortunately, these periods usually do not comply with the periods for which data are available on HUR. On top of that, due to the lack of other equally reliable data, in the investigation it has been ignored that, in some cases, only *estimated* figures were available, and in other there were changes of data collection methods (*break*).

Having regard to these considerations, the study of the relation between HUR and GDP growth rates was made for 33 countries. The number of observations for vast majority of these countries were above 60[13] (see column 4 of table 1).

Next it has been assumed that the GDP growth rate of each country separately [$\mathbf{r_{jt}(GDP)}$] can be expressed as a logarithmic function with constant and respective hyperbolic one of the levels of its harmonised unemployment rate ($\mathbf{HUR_{jt}}$):

$$\mathbf{r^L_{jt}(GDP)} = b^L_{0j} + b^L_{1j}\,\mathbf{(\ln HUR_{jt})} + \boldsymbol{\xi}^{\mathbf{L}}_{\mathbf{jt}} \quad (1)$$

$$\mathbf{r^H_{jt}(GDP)} = b^H_{0j} + b^H_{1j}\,\mathbf{(1/HUR_{jt})} + \boldsymbol{\xi}^{\mathbf{H}}_{\mathbf{jt}} \quad (2)$$

where: j = 1, 2, …, 33 – country number and t = 1, 2, …, t' – quarter number.

[9] Harmonised unemployment rate: all persons, seasonally adjusted, http://stats.oecd.org/index.aspx?DatasetCode=KEI [28 Apr 2014].

[10] Namely for Austria, Czech Republic, Estonia, Germany, Greece, Hungary, Iceland, Israel, Poland, Slovak Republic, Slovenia, Switzerland and Turkey.

[11] Gross domestic product - expenditure approach, growth rate compared to previous quarter, seasonally adjusted, http://stats.oecd.org/WBOS/index.aspx [28 Apr 2014].

[12] Namely for: Belgium, Chile, Czech Republic, Denmark, Estonia, Finland, Germany, Hungary, Iceland, Ireland, Israel, Japan, Luxembourg, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden and Turkey.

[13] Exceptions are: Chile (43), Iceland (44), Ireland (55), Switzerland (16) and Turkey (36).

Lastly it has been assumed that OLS method may be used for estimation of every of the 33 + 33 = 66 equations taking into account, inter alia, that functions (1) and (2) are linear after appropriate transformations.

RESULTS OF THE INVESTIGATION

The results of the research are partially in accordance with expectations. Above all, do not dismay relatively low, and sometimes even very low, values of R^2 because dispersions of points on the vast majority of the 33 charts do not allow to assume in advance any trends (see Annex 1).

Therefore, the estimates of the structural parameter in the logarithmic models of 15 countries[14] are clearly irrelevant statistically (t stat (b^L_{1j}) < 1.00). On the other hand estimates of constant are clearly irrelevant statistically (t stat (b^L_{0j}) < 1.00) in 14 cases, however sometimes for different countries[15] (see columns 6 and 8 in Annex 2).

Slightly better results in this respect has been obtained in case of the hyperbolic models (see 10 and 12 columns of Annex 2). Namely, from the above given list of countries with clearly statistically irrelevant estimates of structural parameters have disappeared Korea and the United Kingdom, and from the list of countries with clearly statistically irrelevant estimates of constant have disappeared as many as 11 countries[16], but 5 new[17] popped up on it.

It is worth noticing that, in general, the type of function does not affect the statistical significance of estimates of the structural parameters while it is not exactly true in case of estimates of constant[18].

Surprising is, however, a significant convergence of both theoretical lines practically for all countries (see Annex 1), despite the fact that the values of the independent variable are clearly (and for some countries by far) different from unity[19]. This is connected with a high negative correlation between estimates of the structural parameters of both functions (see Figure 1).

---

[14] Australia, Canada, Chile, Denmark, Estonia, Germany, Israel, Japan, Korea, New Zealand, Poland, Slovakia, Slovenia, Turkey and the United Kingdom.

[15] From the list disappeared: Israel, Korea, New Zealand, Poland and the United Kingdom and appeared on it: Austria, the Netherlands, Norway and Sweden.

[16] All except for Estonia, Japan and Turkey.

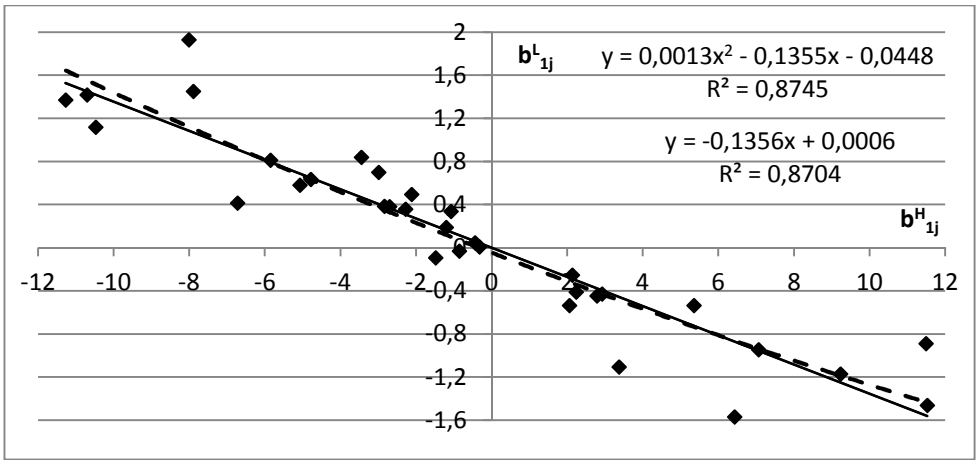
[17] Namely: Iceland, Luxembourg, Mexico, the United Kingdom and the United States.

[18] They are statistically significant in case of both functions for Czech Republic, Finland, France, Hungary and Portugal and almost for Belgium. On the other hand they are statistically relevant in case of hyperbolic functions only for Australia, the Netherlands, New Zealand, Norway, Poland, Sweden and Switzerland and almost for Austria, and in case of logarithmic models only for Ireland, Korea, Luxembourg, Mexico, Spain and the United States and almost for the United Kingdom.

[19] For prove of this statement see, for instance, Kuratowski (1971).

In this context, it should be noted that theoretical lines are compatible with the expected regardless of the type of function only in the case of twelve countries (**Hungary**, Iceland, **Ireland**, Israel, Korea, Luxembourg, Mexico, **Portugal**, **Spain**, Turkey, the United Kingdom and the United States), but only in the case of countries highlighted in bold letters the estimates of structural coefficients are statistically significant[20]. In addition, relevant economically are estimates of the structural parameters in case of logarithmic models for Poland and Slovenia.

Figure 1. Values of b^{L}_{1j} and b^{H}_{1j}



Source: own computations

At the same time, "strategic groups" of countries can be clearly noted, at least for three pairs of the criteria:

a) angle of the (linear) theoretical line r(GDP)^ {∂[r(GDP)^]/(∂[HUR]} and the variability of HUR (the difference between the largest and the smallest values) that is the average change of GDP growth rate, other unchanged, related to the 1 p. p. change in the unemployment rate;
b) the average level of GDP growth rate [r^{av}(GDP)], taking into account the sign of the first derivative of the theoretical curve, and the variation of HUR, as well as
c) the average level of GDP growth rate, taking into account the sign of the first derivative of the theoretical curve, and the average level of HUR [r^{av}(HUR)].

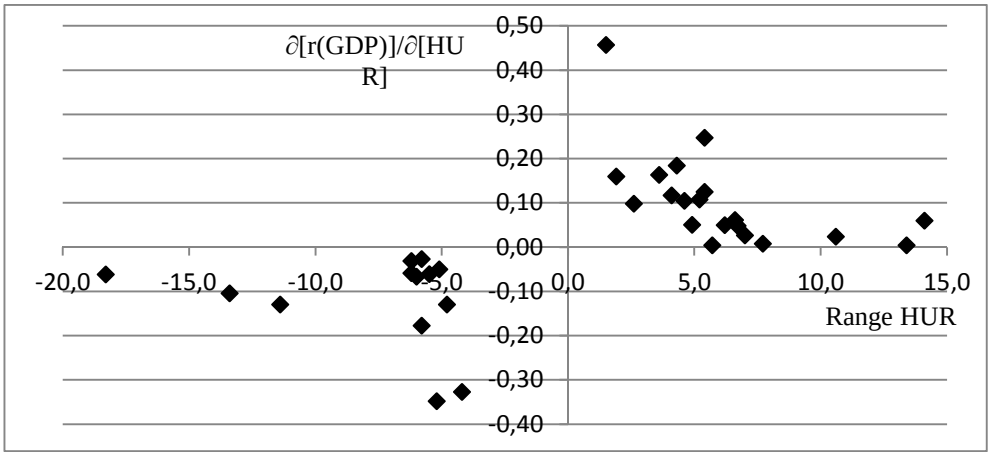
According to the first pair of criteria, countries can be divided, as was mentioned earlier, into two mega-groups (see Figure 2), namely the group of countries with:

[20] By the way it should be noted that three of them (except for Hungary) belong to the so called GIPSI group subject to huge problems during the last economic crisis.

a) a negative first derivative, where the relationships between the levels of unemployment and the rate of GDP levels are in accordance with the Okun's law and
b) a positive first derivative, where these relationships are not in accordance with the Okun's law.

Within the first group covering 13 countries one can distinguish countries with medium (4.2 - 6.2 p. p.) and very large (11.4 - 18.3 p. p.) variations of unemployment rates. On the other hand in the second group one can see countries with small (1.5 - 2.6), medium (3.6 - 7.7) and very large (10.6 - 14.1) variations of these rates. The examined countries can also be divided according to the angle (both negative and positive) into three groups, namely, countries with large, medium and small slopes.[21] Next, combining these two criteria, the examined countries can be divided into nine "strategic groups" (see Annex 3).

Figure 2. Values of the slope of the linear theoretical lines r(GDP)^and the ranges of HUR



Source: own computations

The first "group" consists of countries with medium-sized areas of variation of HUR and theoretical line negative slopes:
a) small: United States, Israel, Slovenia, Turkey, Korea and United Kingdom;
b) medium: Hungary and Mexico;
c) big: Iceland and Luxembourg.

To this group belong also countries with vast areas of HUR variation and:
a) an average negative theoretical line slopes: Ireland and Portugal and
b) small negative theoretical line slope – Spain creating, as the only one, a one-element "group".

[21] On the Figure 2 one can also easily notice the expected inverse relationship between a range of variation of the HUR and the slope of the theoretical line.

On the other hand small positive slope of the theoretical line (0.00 - 0.06) have countries with HUR variation:

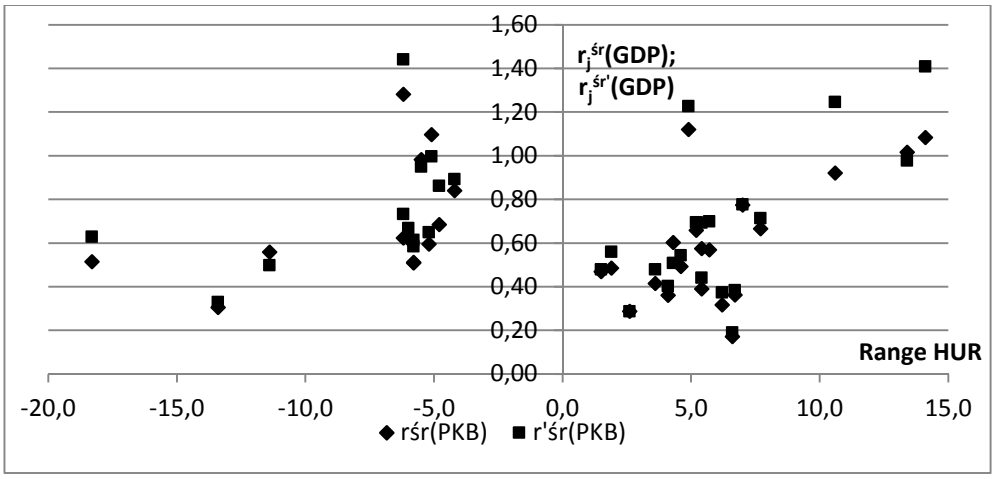
a) very vast: Estonia, Poland and Slovak Republic and
b) medium: Canada, Chile, New Zealand, Australia, Denmark, Germany and Italy.

The last two "strategic groups" according to the criteria in question consist of countries with small or medium ranges of variation of HUR and positive slopes of the theoretical lines:

a) medium (0.10 – 0.18): Japan, Austria, France, Belgium, the Netherlands, Sweden, Finland, Norway and
b) big: Czech Republic (0.25) and Switzerland (0.36).

Use of the second pair of criteria required computation of the average levels of GDP growth rates, $[r_j^{śr}(GDP)]$. However, as one can see in the Annex 1, some extreme, especially negative, GDP growth rates significantly deviated from the respective values directly adjacent to them. In view of this, also the revised average values of GDP growth rates, $[r_j^{śr'}(GDP)]$ have been computed where GDP growth rates significantly varying from the values directly adjacent to them were not included. In total, there were excluded slightly above 5.5% of the all observations, namely: 95 negative values for all 33 countries and 49 positive values for 25 countries. As a result, the adjusted value of the medium GDP growth rates are, on the whole, slightly higher than their uncorrected counterparts (see Figure 3).

Figure 3. Values of ranges of HUR and unadjusted and adjusted average GDP growth rates of OECD countries



Source: own computations

As one can see on the Figure 3, the OECD countries can be classified according to the average (unadjusted and adjusted) levels of GDP growth rates into five classes, namely: countries with a very low, low, medium, high and very high levels of this indicator.

Combining the average GDP rate levels and the ranges of HUR variation, and taking into account the sign of the first derivative of linear theoretical line, the OECD countries can be divided into nine "strategic groups", of which three (Luxembourg, Chile and Korea) are one-element (see Annex 4).

In the case of the uncorrected average GDP growth rates in the first mega-group are four "strategic groups" consisting of the countries with:

a) very large volatilities of unemployment rates and low (Portugal) and medium average GDP growth rates (Spain and Ireland);
b) medium volatility of unemployment rates and medium average GDP growth rates (United States, Mexico, Iceland, United Kingdom, Hungary and Slovenia);
c) medium volatility of unemployment rates and high average GDP growth rates (Luxembourg, Israel and Turkey) and
d) medium volatility of unemployment rates and a very high average GDP growth rate (Korea).

On the other hand in the second mega-group there are six "strategic groups" consisting respectively of countries with:

a) very small volatilities of unemployment rates and low (Japan) and medium levels of the average growth rate of GDP (Switzerland and Austria);
b) small volatilities of unemployment rates and low (Belgium, France and Finland) and medium levels of the average growth rate of GDP (Canada, The Netherlands, Norway, Sweden and Czech Republic);
c) small volatilities of unemployment rates and high level of the average growth rate of GDP (Chile);
d) medium volatilities of unemployment rates and very low (Italy) and low (Denmark and Germany) levels of the average growth rate of GDP;
e) medium volatilities of unemployment rates and medium (New Zealand) and high (Australia) levels of the average growth rate of GDP;
f) high volatilities of unemployment rates and high levels of the average growth rate of GDP (Slovak Republic, Poland and Estonia).

The results in case of the adjusted average GDP growth rates are basically similar, taking into account, of course, changes in their ranges and the overall increase in their levels (due to the predominance of missed negative values). However, Israel and Turkey on one hand and Poland and Slovakia on the other have changed their positions within the frameworks of their "strategic groups", while Mexico and Estonia "improved" their positions, moving to the next "strategic groups"' relative to the levels of the average growth rates of GDP. As a result, Mexico (as well as Israel and Turkey) joined Luxembourg and Estonia has become one-element group.

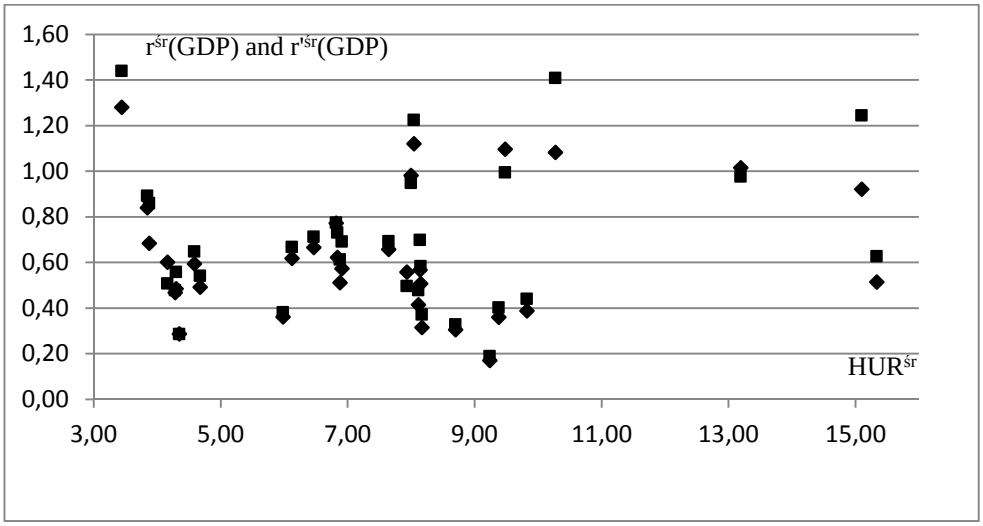
As already mentioned the last pair of the analysed criteria constitute the average levels of GDP and average levels of unemployment[22], ($HUR^{śr}$). According

[22] In the case of unemployment rates there is no sense to take into account the adjusted average rates, because the relative differences between adjusted and unadjusted rates are

to the average levels of unemployment the analysed countries can be divided into five classes, namely: countries with a very low (3.44), low (3.84 – 4,67), medium-5,98 6,91), high (7,64-10,27) and very high (13,19-15,33) levels of this indicator (see Figure 4). In this context it is worth noting that the changes both of the average as well as of the adjusted average GDP growth rates do not depend upon the changes of the average rates of unemployment[23].

Combining these two criteria, the analysed OECD countries can be divided into ten "strategic groups". Among them there is only one one-element group (see Annex 5).

Figure 4. Values of the average unemployment rates and unadjusted and adjusted average GDP growth rates of OECD countries



Source: own computations

A class for everyone is Korea that has a very high average growth rate of GDP and a very low level of the average unemployment rate. Slightly lower levels of the average GDP growth rates had also Chile and Israel, but at high average rates of unemployment, as well as Estonia, Poland and Turkey that had very high levels of unemployment rates.

High levels of average GDP growth rates were accompanied by small, medium and very high levels of unemployment in Luxembourg, Australia, Slovakia, respectively.

negligible (only in two cases these differences exceed the level of 3% (for Spain, the difference is about 3.3%, and for Turkey it is approx. -4.5%).

[23] For example, assuming a linear relationship, increase of $HUR^{śr}$ by 1 p. p. is associated with an about 0.01 p. p. increase in $r^{śr}(GDP)$ ($R^2 = 0.01$) and an about 0.02 p. p. increase in $r^{śr}$'(GDP) (R2 = 0.03).

On the other hand, the average levels of the GDP growth rates corresponded to the different average interest levels of unemployment:

a) low: Switzerland, Austria, the Netherlands, Norway, Iceland and Mexico;
b) medium: United Kingdom, The Czech Republic, Slovenia, the United States and New Zealand;
c) high: Hungary, Sweden, Ireland and Canada and
d) very high: Spain.

Several countries have low levels of the average GDP growth rates. In Japan it was accompanied by low, in Denmark by medium and in Germany, Belgium, France, Portugal and Finland by high average unemployment rates.

Very low average growth rate of GDP accompanied by a high level the average unemployment rate was reached by Italy.

Unfortunately, it is difficult to distinguish other criteria, except for the above given formal ones, for the classification of the individual countries to the given and not to the other "strategic group". In other words, it is difficult to determine the common substantive features that have the countries classified to the given "strategic group".

It should be noted, however, that in the same "groups" or in very close proximity on all three "maps" there are, for example:

a) Australia and New Zealand;
b) Austria, Switzerland, the Netherlands and Norway;
c) Belgium, France and Finland;
d) Estonia, Poland and Slovak Republic;
e) Spain, Ireland, Portugal and Hungary;
f) Israel and Turkey;
g) Luxembourg, Iceland and Mexico;
h) Slovenia and Hungary and United Kingdom, United States and Mexico;
i) Italy, Germany, Denmark and Belgium.

In most of the above cases one can trace to, in addition to the above-mentioned formal criteria also economic, political, geographical, historical or other conditions effecting in "likeness" of countries classified into the same "strategic group" or neighbouring ones. Analysis, both of "similarities" according to different criteria of the countries classified to the same "strategic group", as well as the differences between them, as well as of the differences between the various "strategic groups" will be carried out in the nearest future. It should contribute to the implementation of the mentioned in the second paragraph of this paper, main aim of the whole research study, i.e. formulation (separately for each country) of the accurate recommendations with respect to the direction of movement of the experiential long-term equilibrium point towards the "optimal" one, or in other words of the mid-term and final recommendations for macro-economic policy makers of the individual countries.

PRELIMINARY RECOMMENDATIONS FOR THE ECONOMIC POLICYMAKERS

Recommendations for the economic (and social) policy makers that can be derived on the basis of the results of the above discussed research study are limited because of the assumptions and the research method, as well as because of the availability of the statistical data. Namely, they affected the levels of statistical measures of the results of the survey and, finally, the classification of individual countries into the relevant "strategic groups".

Nevertheless, a thorough analysis of the values of every of the classification criteria in relation to the countries included in the respective "strategic groups" allows to make the following preliminary recommendations[24]:

1. Switzerland, Czech Republic, Norway, Belgium, Austria, Finland, France, Sweden, the Netherlands, Japan, Italy, Estonia, Chile, Germany, Denmark, Australia, Slovakia, New Zealand and Canada, as well as possibly Poland and Slovenia should determine:
   a) list factors affecting relationships between the levels of unemployment and the growth rates of GDP;
   b) the relationships between these factors and the shape and location of the Okun's curve;
   c) list of actions that will result in changes in the shape (the slope) and location of the Okun's curve.
2. the United Kingdom, Korea, Turkey, Israel, the United States and possibly Spain and also Poland and Slovenia should determine:
   a) list of factors influencing volatility of the unemployment rates;
   b) the relationships between these factors and volatility of the unemployment rates;
   c) list of actions that would result in the reduction of this volatility, and simultaneously, the change in shape (increase of the slope) and location of the Okun's curve.
3. all countries, perhaps with the exception for Korea, Luxembourg, Mexico, Norway, Switzerland, Austria, Japan, Iceland and the Netherlands should determine:
   a) list of factors influencing unemployment rates;
   b) the relationships between these factors and unemployment rates;
   c) list of actions that would result in reduction of the unemployment rates, and simultaneously change of the position of the (lowering) and the shape of the Okun's curve.

[24] The orders of listing the countries in this and in the next point indicate the scale and perhaps the urgency of respective actions and in third point countries are appearing in the reverse order.

These recommendations are preliminary. Some more detailed recommendations for macroeconomic policymakers of the respective countries will be formulated after solution, for every country separately, of the equation (5), as indicated in paragraph 3 of this paper and considerations, separately for every country, on the location of the "optimal" long term equilibrium point.

REFERENCES

Abel A. B., Bernanke B. S., Macroeconomics (5th ed.). Pearson Addison Wesley 2005.

Błaszczuk D. J., Cele polityki gospodarczej: zależność między stopą inflacji a stopą bezrobocia w krajach OECD w latach 1990 – 2013, IV Ogólnopolska Konferencja im. Zbigniewa Czerwińskiego „Matematyka i informatyka na usługach ekonomii", Uniwersytet Ekonomiczny w Poznaniu, Poznań 25 kwietnia 2014.

Błaszczuk D. J., Economic Policy Targets: Relationships between Inflation and GDP Growth Rates in OECD Countries in 1990 - 2013, III Konferencja Naukowa „Spatial Econometrics and Regional Economic Analysis, Uniwersytet Łódzki, Wydział Ekonomiczno-Socjologiczny, Łódź, 09-10 czerwca 2014.

Durech R., Minea A., Mustea L. T., Slusna L., Regional evidence on Okun's Law in Czech Republic and Slovakia, Economic Modelling 2014,v. 42, pp. 57-65.

http://stats.oecd.org/index.aspx?DatasetCode=KEI [28.04.2014].

http://stats.oecd.org/WBOS/index.aspx [28.04.2014].

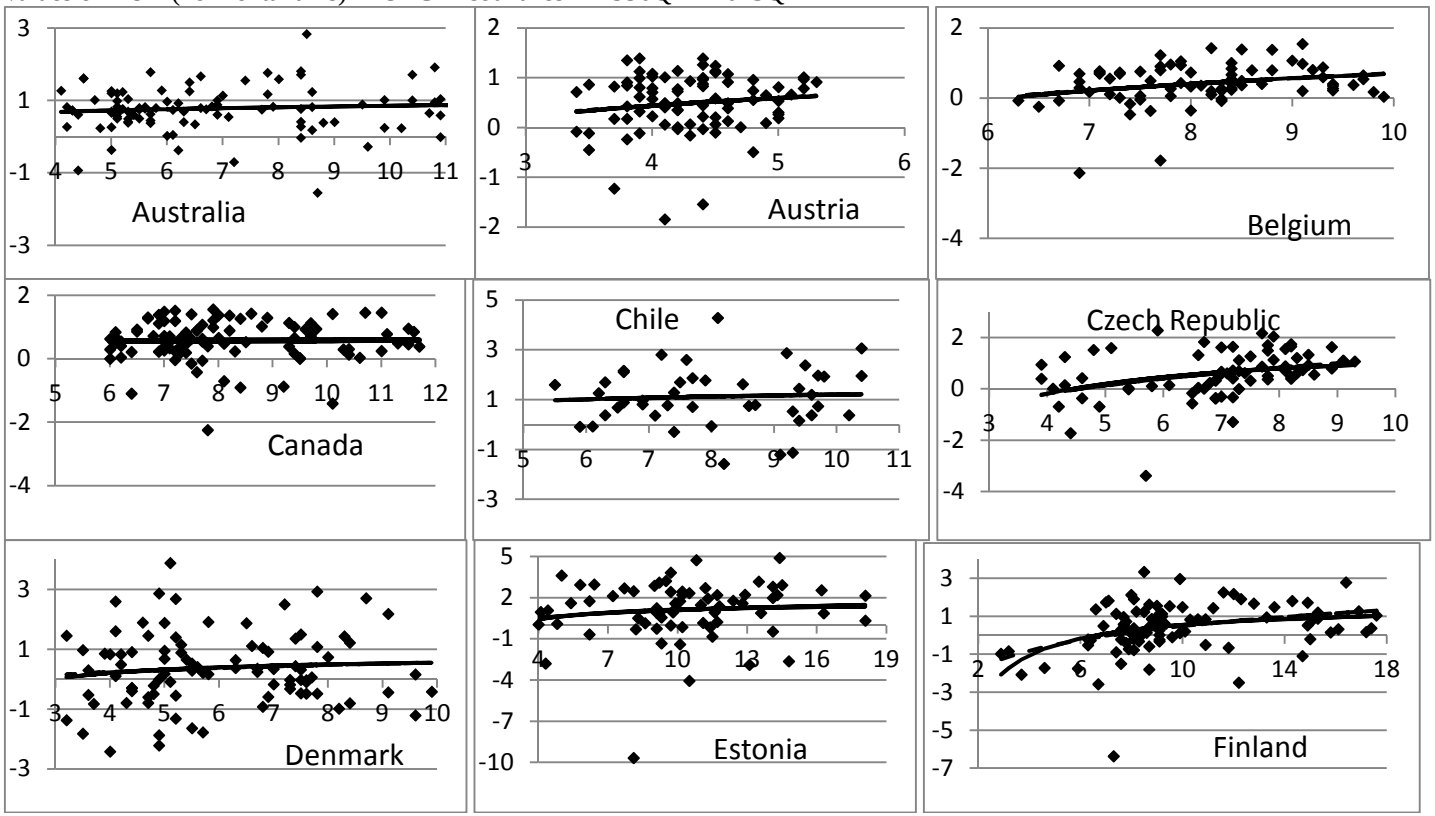
Klimczyk P., Wronowska G., Prawo Okuna w warunkach kryzysu gospodarczego, Wzrost gospodarczy i polityka makroekonomiczna (eds. W. Kwiatkowska, E. Kwiatkowski,

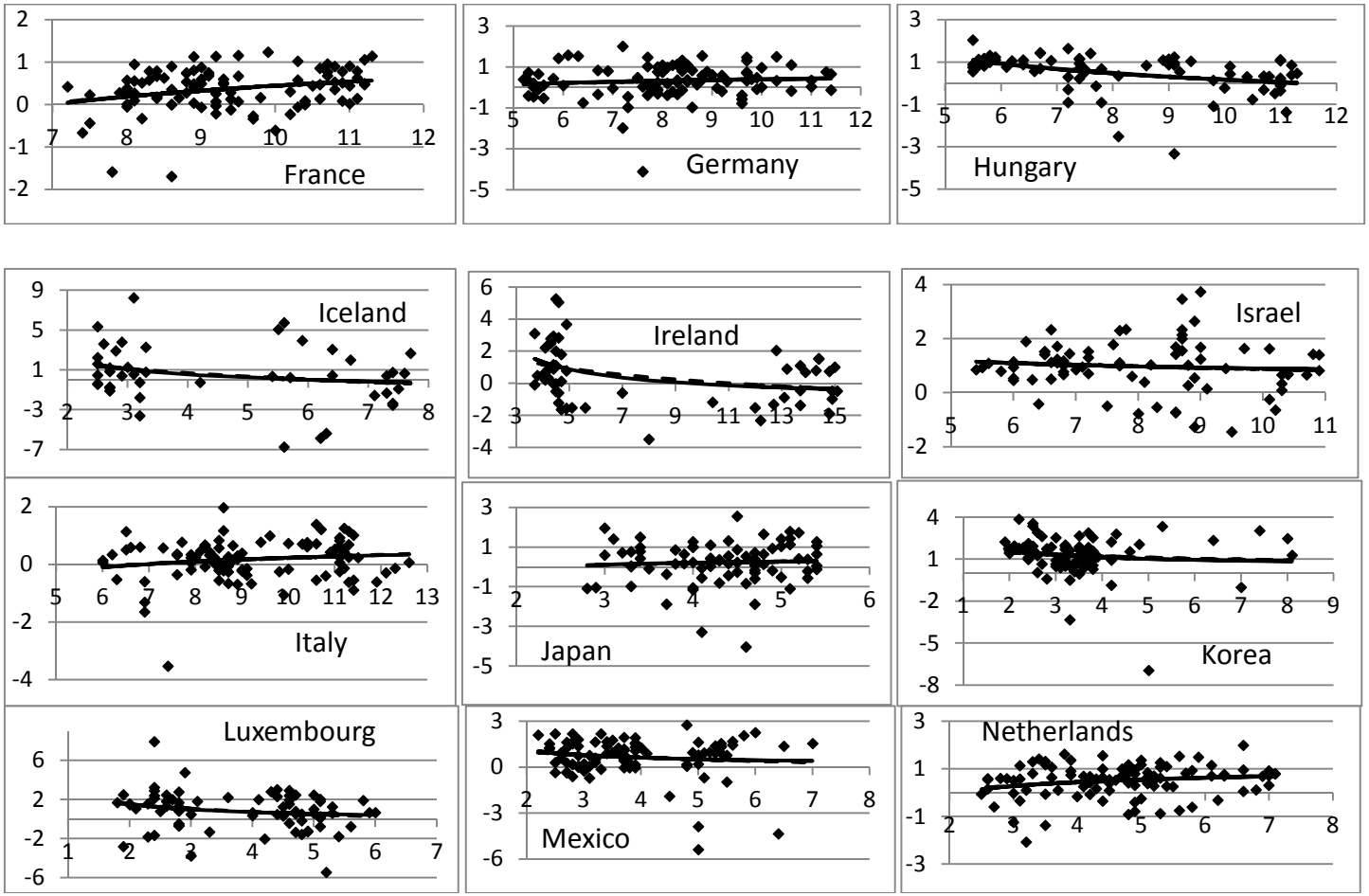
Uniwersytet Łódzki, Łódź 2010, pp. 263-272.

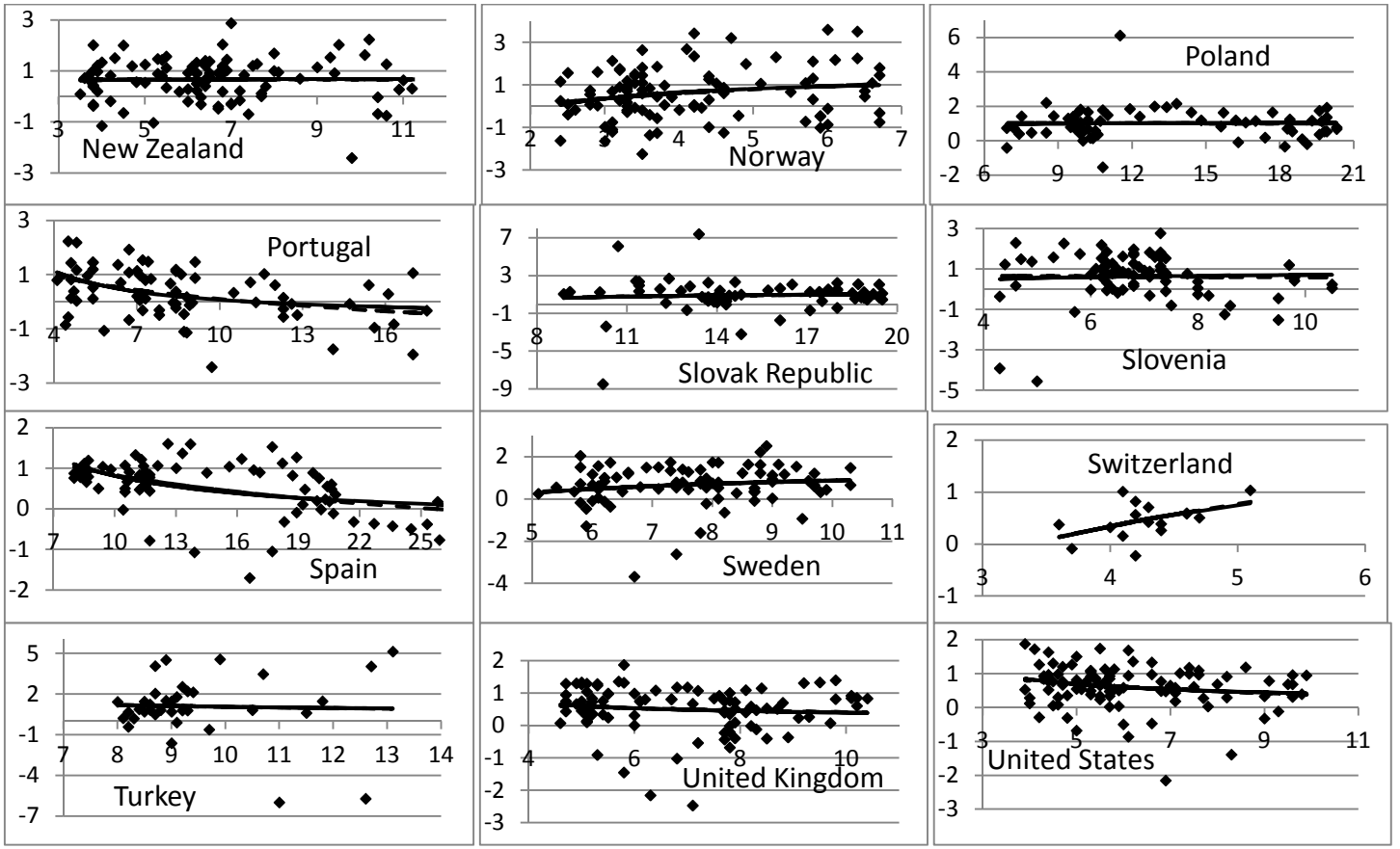
Kuratowski K., Rachunek różniczkowy i całkowy, PWN, Warszawa 1971.

Okun A., Potential GNP: Its Measurement and Significance, American Statistical Association, Proceedings of the Business and Economics Statistics Section 1962, pp. 98-104.

Annex 1. Empirical and theoretical (logarithmic – solid lines, hiperbolic – broken lines) values of r(GDP) (verical axis) and empirical values of HUR (horizontal axis) in OECD countries in 1990Q1 – 2013Q4




France
Germany
Hungary
Iceland
Ireland
Israel
Italy
Japan
Korea
Luxembourg
Mexico
Netherlands



Source: own computations

Annex 2. Results of estimation

No	Country	Observations		r(GNP) =f(ln(HUR)				r(GNP) =f(1/HUR)			
		from	T	b^L_{1j}	t Stat	b^L_{0j}	t Stat	b^H_{1j}	t Stat	b^H_{0j}	t Stat
1	Australia (AU)	Q1-1990	96	0,188	0,81	0,419	0,94	-1,204	0,78	0,964	3,80
2	Austria (A)	Q1-1993	84	0,697	1,14	-0,527	0,59	-2,990	1,15	1,189	1,94
3	Belgium (B)	Q2-1995	75	1,371	2,25	-2,448	1,92	-11,271	2,31	1,821	2,98
4	Canada (CA)	Q1-1990	96	0,045	0,12	0,476	0,61	-0,442	0,15	0,625	1,59
5	Chile (CHI)	Q2-2003	43	0,383	0,37	0,328	0,15	-2,835	0,35	1,484	1,41
6	Czech Republic (CZ)	Q2-1996	71	1,449	3,12	-2,191	2,46	-7,895	2,87	1,776	4,11
7	Denmark (DE)	Q2-1991	91	0,356	0,78	-0,260	0,32	-2,281	0,92	0,775	1,66
8	Estonia (EST)	Q1-1997	68	0,632	0,84	-0,354	0,20	-4,788	0,82	-4,788	0,82
9	Finland (SF)	Q2-1990	95	1,417	3,77	-2,770	3,27	-10,707	3,85	1,615	4,70
10	France (F)	Q1-1990	96	1,117	2,63	-2,131	2,24	-10,479	2,67	1,494	3,49
11	Germany (G)	Q2-1995	91	0,382	0,91	-0,479	0,54	-2,702	0,86	0,662	1,62
12	Hungary (H)	Q1-1996	72	-1,465	3,68	3,539	4,27	11,525	3,75	-0,991	2,41
13	Iceland (IC)	Q1-2003	44	-1,571	1,53	2,842	1,86	6,426	1,51	-1,086	0,91
14	Ireland (IR)	Q2-2000	55	-1,173	2,73	2,809	3,28	9,233	2,99	-0,985	1,74
15	Israel (IS)	Q2-1995	75	-0,431	0,74	1,872	1,55	2,919	0,65	0,604	1,01
16	Italy (IT)	Q1-1990	96	0,579	1,46	-1,107	1,26	-5,076	1,47	0,739	1,88
17	Japan (J)	Q2-1994	79	0,335	0,47	-0,269	0,26	-1,076	0,38	0,472	0,69
18	Korea (K)	Q1-1990	96	-0,412	0,89	1,769	3,11	2,237	1,41	0,568	1,08
19	Luxembourg (L)	Q2-1995	75	-1,108	1,74	2,270	2,67	3,371	1,62	-0,145	0,22
20	Mexico (M)	Q1-1990	96	-0,538	1,17	1,392	2,25	2,054	1,20	0,112	0,23
21	Netherlands (NE)	Q1-1990	96	0,495	1,89	-0,252	0,63	-2,113	1,95	0,979	3,78
22	New Zealand (NZ)	Q1-1990	96	0,006	0,02	0,655	1,30	-0,321	0,20	0,720	2,54
23	Norway (N)	Q1-1990	96	0,837	1,99	-0,555	0,93	-3,447	2,04	1,503	3,29
24	Poland (PL)	Q1-1997	68	-0,032	0,09	1,098	1,25	-0,855	0,20	1,089	2,92
25	Portugal (PT)	Q1-1996	72	-0,947	3,61	2,281	4,10	7,059	3,40	-0,637	2,16
26	Slovak Republic (SL)	Q1-1998	64	0,414	0,36	-0,193	0,06	-6,728	0,42	1,386	1,23
27	Slovenia (SV)	Q1-1996	72	-0,094	0,13	0,802	0,56	-1,478	0,31	0,848	1,15
28	Spain (ES)	Q2-1995	75	-0,889	4,71	2,885	5,68	11,490	4,32	-0,338	1,61
29	Sweden (S)	Q2-1993	83	0,811	1,36	-0,980	0,81	-5,853	1,34	1,448	2,42
30	Switzerland (CH)	Q1-2010	16	1,928	2,04	-2,328	1,70	-8,013	2,00	2,354	2,49
31	Turkey (TQ)	Q1-2005	36	-0,537	0,18	2,300	0,35	5,354	0,18	0,522	0,16
32	United Kingdom (UK)	Q1-1990	96	-0,256	0,84	0,998	1,72	2,131	1,06	0,184	0,58
33	United States (US)	Q1-1990	96	-0,448	1,75	1,415	3,08	2,787	1,81	0,133	0,48

Source: own computations

Annex 3. Map of "strategic groups" of OECD countries according to the slope of the linear theoretical line between the GDP growth rate and HUR and HUR variation areas

∂[r(GDP)]/∂[HUR)]	-0,35 – -0,33	-0,18 – -0,10	-0,07 – -0,03	0,00 - 0,06	0,10 - 0,18	0,25 - 0,46
-18,3			ES			
-13,4 - -11,4		IR PT				
-6,2 – -4,2	IC L	H M	US[a)] IS SV TQ K UK			
1,5 - 2,6					J A	CH
3,6 - 5,7				CA CHI	NE S F SF B N	CZ
6,2 - 7,7				NZ AU DE G IT		
10,6				SL		
13,4 - 14,1				PL EST		

Range HUR

Source: own computations

Legend: a) The yearly slope ∂[r(GDP)]/∂[HUR)] ≈ 0.25 p. p. is evidently lower than estimated by M. F. Prachovny and even by A. B. Abel and B. S. Bernanke.

Annex 4. Map of "strategic groups" of OECD countries according to the range of variation of unemployment and the average (unadjusted and adjusted[a)]) levels of GDP growth rates

$r^{śr}$(GDP)	0,17	0,29 - 0,41	0,47 - 0,68	0,77 - 0,92	0,98 - 1,12	1,28
$r^{śr'}$ (GDP)	0,19	0,29 - 0,44	0,48 - 0,73	0,78 - 1,00	1,23 - 1,25	1,41 - 1,44
-18,3			ES			
-13,4 - -11,4		PT	IR			
-6,2 - -4,2			SV US UK H IC M	IS' TQ' M' L	IS TQ	K
1,5 - 2,6		J	CH A			
3,6 - 5,7		B F SF	N NE S CZ CA		CHI	
6,2 - 7,7	IT	G DE	NZ	AU		
10,6				SL	SL'	
13,4 - 14,1				PL'	PL EST	EST'

Range HUR

Source: own computations

Legend: a) countries classified according to adjusted index to other group than according to the unadjusted one are marked by the sign '.

Annex 5. Map of "strategic groups" of OECD countries according to the levels of $r^{śr}$(GDP) and $r^{śr}$'(GDP) and $HUR^{śr}$

$r^{śr}$(GDP)	0,17	0,29 - 0,41	0,47 - 0,68	0,77 - 0,92	0,98 - 1,12	1,28
$r'^{śr}$(GDP)	0,19	0,29 - 0,44	0,48 - 0,73	0,78 - 1,00	1,23 - 1,25	1,41 - 1,44
3,44						K
3,84 - 4,67		J	CH A NE IC N M	L M'		
5,98 - 6,91		DE	UK CZ US SV NZ	AU		
7,64 - 8,17		G B	H IR CA S		IS CHI	
8,70		PT				
9,24 - 10,27	IT	F SF		TQ'	EST TQ	EST'
13,19 - 15,33			ES	SL PL'	PL SL'	

$HUR^{śr}$

Source: own computations