

Model approach to the analysis of fulfilment of the Lisbon criteria

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Lisbon Criteria - History

March 2000, Lisbon:

negotiation on the Lisbon criteria (Chairs of government of all EU countries) in order to achieve the competitiveness to the world economics of the USA and Japan by transforming the EU into the „most dynamic and competitive knowledge-based economy in the world“ by 2010,

March 2004, Brusel:

1. analysis of the Lisbon criteria fulfillment – insufficient
2. appointment of the expert group – chief Wim Kok (former Dutch prime minister) – to introduce dynamics into reforms

Spring each year:

Centre for European Reform evaluates the situation in the area of fulfillment of the Lisbon criteria

Lisbon indicators

General economic background	1 GDP per capita (in purchasing power standards)
	2 Labour productivity per person employed
Employment	3 Employment rate
	4 Employment rate of older workers
Innovation and research	5 Gross Domestic Expenditure on R&D
	6 Youth attainment level
Economic reform	7 Comparative price levels
	8 Business investment
Social cohesion	9 At-risk-of poverty rate after social transfers
	10 Dispersion of regional employment rates
	11 Long-term unemployment rate
Environment	12 Total greenhouse gas emissions
	13 Energy intensity of the economy
	14 Volume of freight transport relative to GDP

Partial Priorities

- Investment into research and development (R&D) at the level of 3 % GDP,
- reduction of administration documentation and support of entrepreneurial environment,
- to increase the employment of the total labour force to the level of 70 % (60 % for women),
- to support IT society, development and research,
- acceleration of the structural reforms process,
- investment into human capital,
- application of the suitable macroeconomic policy.

Every member country was invited to determine the responsibility for the national aims or priorities in accordance with their starting position.

Main aims of the presentation

Four questions:

1. What can induce the increased investment in research and development?
2. What can induce the increased employment of women on expected level of 60 percent?
3. How to ensure the increase of growth of GDP per inhabitant.
4. If the individual countries will be able to fulfill the mentioned targets by 2010.

Methodology of panel data – Countries Used for Analysis

EU countries – member states which became EU members in 1 May 2004:

1. Czech Republic (CZ)
2. Estonia (EE)
3. Cyprus (CY)
4. Latvia (LV)
5. Lithuania (LT)
6. Hungary (HU)
7. Malta (MT)
8. Poland (PL)
9. Slovenia (SI)
10. Slovakia (SK)

Model of the panel data

Cross-sectional parameters relied on exogenous instrumental traditionally.

The identification of time series parameters was usually based on notions of stationarity, predeterminedness and uncorrelated shocks.

The work with panel data allows using all these resources and at the same time determines economists to thing more about the nature and applicability of a particular technique to identify a parameter of potential interest.

Panel data are now being increasingly used in economic research. Panel data models have become increasingly popular due to height capacity for capturing the complexity of human behavior as compared to cross-sectional or time-series data models.

Basis model

In this case we take into account the „individuality“ of each country . Let the intercept vary for each country but still assumes that the slope coefficients are constant across individuals.

Let us consider following model:

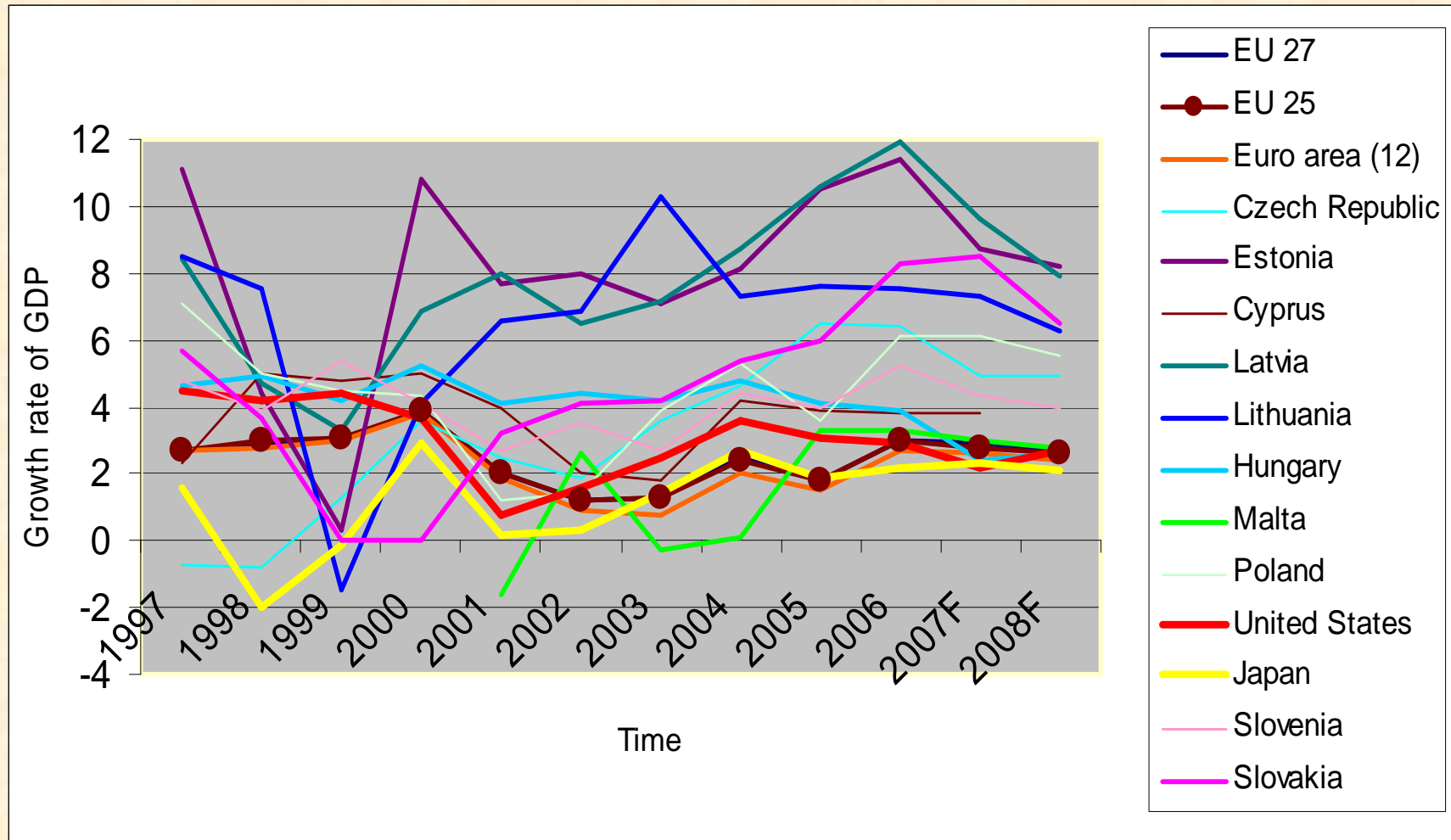
$$y_{it} = \beta_{0i} + \beta_1 x_{1it} + \beta_2 x_{2it} + u_{it}$$

for $i = 1, 2, 3, \dots, 10$ and $t = 1, 2, 3, \dots, 12$.

This model is famous as Fixed Effect Model (FEM).

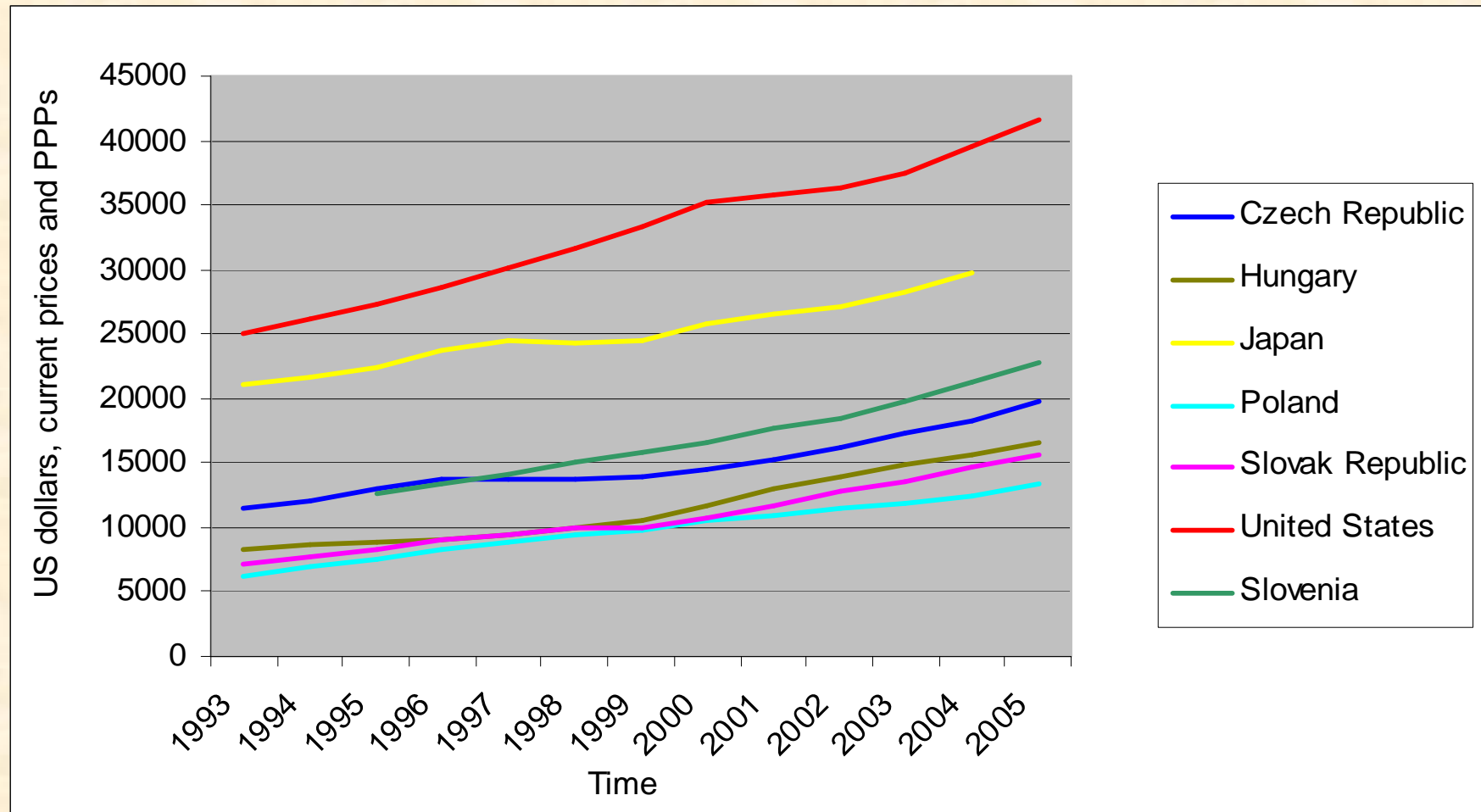
Rate of GDP volume

percentage change on previous year



Gross national income per capita

US dollars, current prices and PPPs



The model of GDP per inhabitant

$$gdpein_{it} = \beta_{0i} + \beta_1 \cdot pp_{it} + \beta_2 \cdot w_{it} + u_{it}$$

where

$gdpein_{it}$ - Gross domestic product at market prices, Euro per inhabitant,

pp_{it} - Labour productivity per person employed - GDP in PPS per person employed relative to EU-25 (EU-25=100),

w_{it} - Wages and salaries, Euro per inhabitant,

u_{it} - Disturbance.

The model of employment growth

To answer the second question the linear econometric model was specified (we concentrate on employment of women):

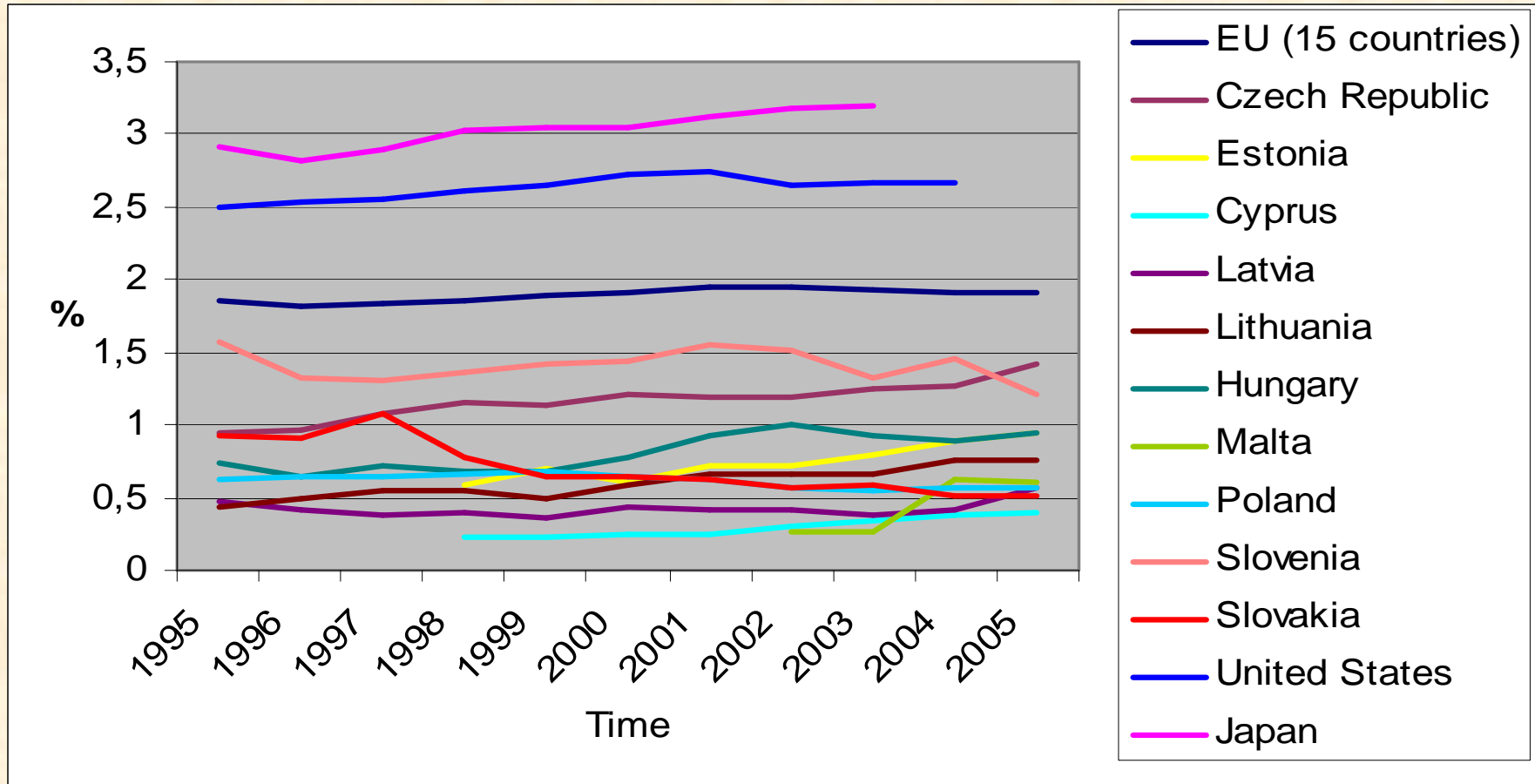
$$ef_{it} = \beta_{0i} + \beta_1 \cdot gdp_{it-1} + \beta_2 \cdot edu_{it} + \beta_3 \cdot hicp_{it} + u_{it}$$

where

- ef_{it} - Employment growth - females - Annual percentage change in female employed population
- gdp_{it-1} - GDP per capita in PPS - (EU-25=100),
- edu_{it} - Total public expenditure on education as % of GDP, for all levels of education combined,
- $hicp_{it}$ - Annual average rate of change in Harmonized indices of consumer prices.

R&D

percentage of GDP



Model of R&D

We can write the resultant model:

$$rad_{it} = \beta_{0i} + \beta_1 \cdot gdp_{it} + \beta_2 \cdot ur_{it} + u_{it}$$

where

rad_{it} - Gross domestic expenditure on R&D

ur_{it} - harmonized long-term unemployment rates

For testing the presence of autocorrelation there was used in each estimated model autocorrelation scheme AR(1) :

$$u_{it} = \rho \cdot u_{it-1} + v_{it}$$

Empirical Results

- All estimates were realized on the base year's panel data from 1995 to 2006 with econometric software Eviews 5.1.
- For estimation of parameters was applied method Panel Least Squares.
- All estimated parameters are statistically significant on level of significance lower than 5 %.

Model of GDP per inhabitants

Name	Estimated parameters
c_cz	-2 066,3
c_ee	-1 822,6
c_cy	-3 157,9
c_lv	-1 586,1
c_lt	-1 675,9
c_hu	-2 715,7
c_mt	-4 533,2
c_pl	-2 222,6
c_si	-4 732,8
c_sk	-2 014,4
w	2,3

Model of women's employment

Since the data of women's employment in Malta were about 32,1 – 35,1 % and of other analyzed countries was 50 – 69 %, we estimated the same model on panel data for 9 countries (Panel 9), without Malta.

For comparison see next table.

Model of women's employment

Name	Panel 10	Panel 9	Dif.
	Estimate parameter		
c_cz	30,14	25,24	4,90
c_ee	40,22	37,26	2,96
c_cy	21,95	15,96	5,99
c_lv	39,79	37,34	2,44
c_lt	41,50	38,84	2,67
c_hu	23,68	19,65	4,03
c_mt	-2,41	-	-
c_pl	28,44	25,09	3,35
c_si	25,13	19,70	5,43
c_sk	31,67	28,04	3,64
GDP(-1)	0,39	0,47	-0,08
EDU	1,21	1,16	0,05
HICP	0,26	0,29	-0,03

Model of R&D

Name	Estimated parameters
c_cz	0,68
c_ee	0,42
c_cy	-0,43
c_lv	0,19
c_lt	0,39
c_hu	0,38
c_mt	-0,15
c_pl	0,35
c_si	0,79
c_sk	0,36
gdp	0,01
ur	-0,02

Forecasting

In the next step we used the estimated models to forecast to all dependent variables for years 2007 – 2010.

Results are concentrated in next tables.

Forecasting GDP per inhabitant

	2007	2008	2009	2010
CZ	9 762,46	10 229,42	10 696,39	11 163,35
EE	9 354,36	10 006,32	10 658,27	11 310,22
CY	19 444,75	20 184,97	20 925,19	21 665,41
LV	6 620,74	7 066,23	7 511,73	7 957,23
LT	7 446,52	7 521,48	8 006,45	8 491,43
HU	9 452,74	10 011,52	10 570,31	11 129,09
MT	12 465,53	13 047,06	13 565,73	14 084,41
PL	6 775,61	7 091,86	7 408,11	7 724,36
SI	15 396,49	16 071,80	16 747,12	17 422,44
SK	7 865,04	8 443,01	9 020,99	9 598,96

Forecasting of Women's employment

	2007	2008	2009	2010	Panel
CZ	66,3	67,0	67,9	68,7	i=10
	66,9	67,8	68,7	69,7	i=9
EE	73,1	73,6	75,0	76,3	i=10
	74,8	75,4	77,0	78,6	i=9
CY	66,9	67,4	68,0	68,6	i=10
	67,2	67,7	68,3	69,0	i=9
LV	68,5	69,8	71,3	72,8	i=10
	69,8	71,4	73,2	74,9	i=9
LT	70,7	71,6	72,7	73,9	i=10
	71,9	73,0	74,3	75,6	i=9
HU	57,2	58,2	58,9	59,6	i=10
	57,7	58,8	59,6	60,5	i=9
MT	30,8	32,1	33,7	36,8	i=10
	-	-	-	-	i=9
PL	56,1	56,3	57,5	60,1	i=10
	56,3	56,5	58,4	60,5	i=9
SI	67,1	67,0	67,5	68,0	i=10
	67,7	67,5	68,1	68,6	i=9
SK	61,2	60,9	61,3	61,7	i=10
	61,8	61,4	61,9	62,4	i=9

Forecasting of Gross domestic expenditure on R&D

	2005	2007	2008	2009	2010
CZ	1,42	1,30	1,32	1,34	1,36
EE	0,94	0,92	0,95	0,98	1,01
CY	0,4	0,36	0,38	0,39	0,41
LV	0,57	0,63	0,66	0,70	0,74
LT	0,76	0,81	0,84	0,87	0,90
HU	0,94	0,93	0,94	0,95	0,97
MT	0,61	0,42	0,43	0,46	0,47
PL	0,57	0,63	0,64	0,65	0,66
SI	1,22	1,48	1,49	1,51	1,52
SK	0,51	0,67	0,69	0,70	0,72

Change of Gross domestic expenditure on R&D

	2005	2010	Change (%)
CZ	1,42	1,36	-4,48
EE	0,94	1,01	7,62
CY	0,4	0,41	2,09
LV	0,57	0,74	30,11
LT	0,76	0,90	18,54
HU	0,94	0,97	3,12
MT	0,61	0,47	-23,77
PL	0,57	0,66	16,37
SI	1,22	1,52	24,56
SK	0,51	0,72	41,26

Conclusion

- According to our estimated linear models it can be said that the investigated criteria (GDP per inhabitant and employment of women) will be fulfilled by 2010 in all analysed countries with exception of Malta.
- Acquirement of 3 % (level Japan and United State) of expenditure on research and development will be very hard in majority of new member EU countries. The foundation for fulfilment of this criterion should be economic growth and allocated financial resources budget in every country.
- Taken together, our econometric models are too much simple. For complex evaluation and macroeconomics criterions will be better used multi equation model, because only this multi equation model receives fiscal and monetary policy together. Only with the right combination of both policies it will be possible to get desirable results.
- This paper is only starting point for next research in this field. Estimated models will be used in multi equation model.