

Forecasting Tax Revenues in Latvia: Analysis and Models

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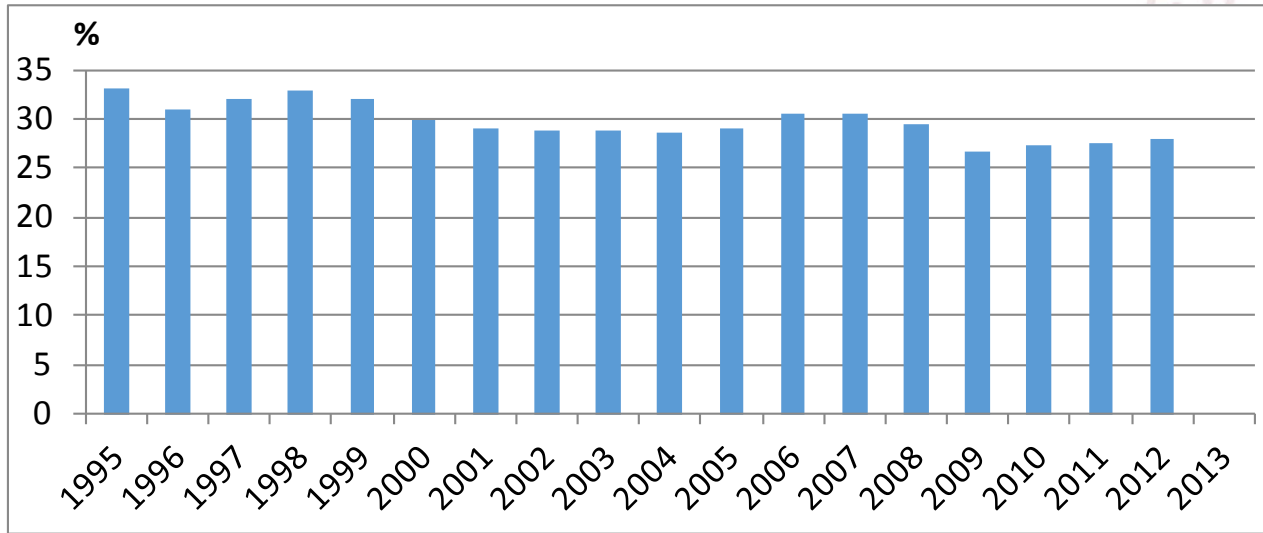


Data Analysis

- CSB data
- Ministry of Finance data
- State Revenue Service (SRS) data
- Eurostat data

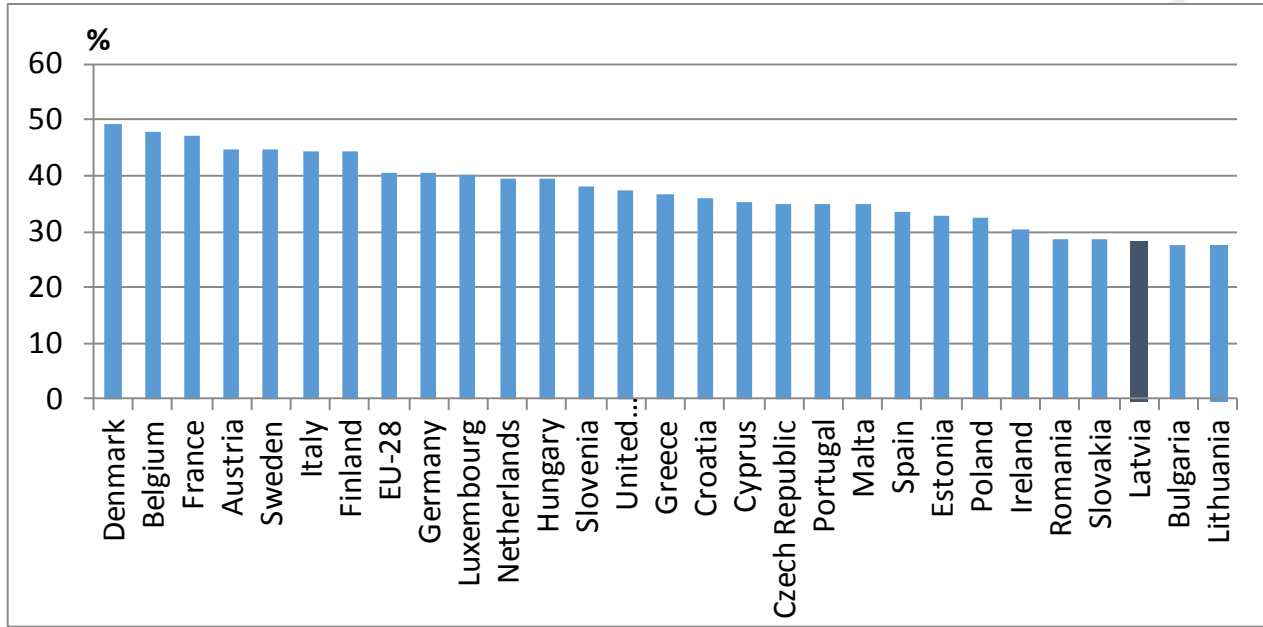


Tax Burden in Latvia in 1995-2012, % of GDP



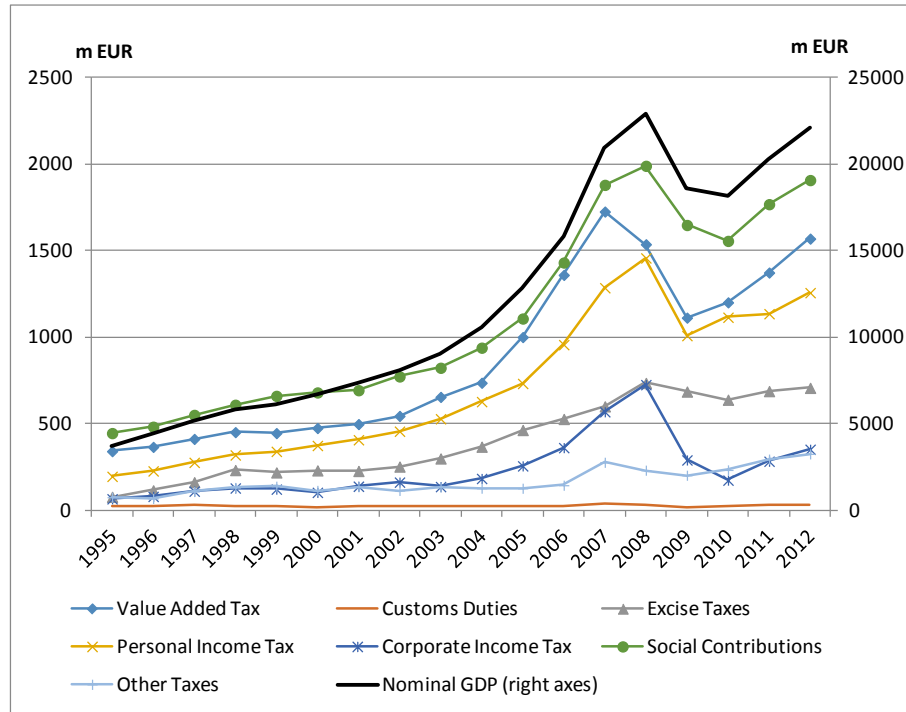
Data Source: CSB database

Tax Burden in the EU Countries in 2012, % of GDP

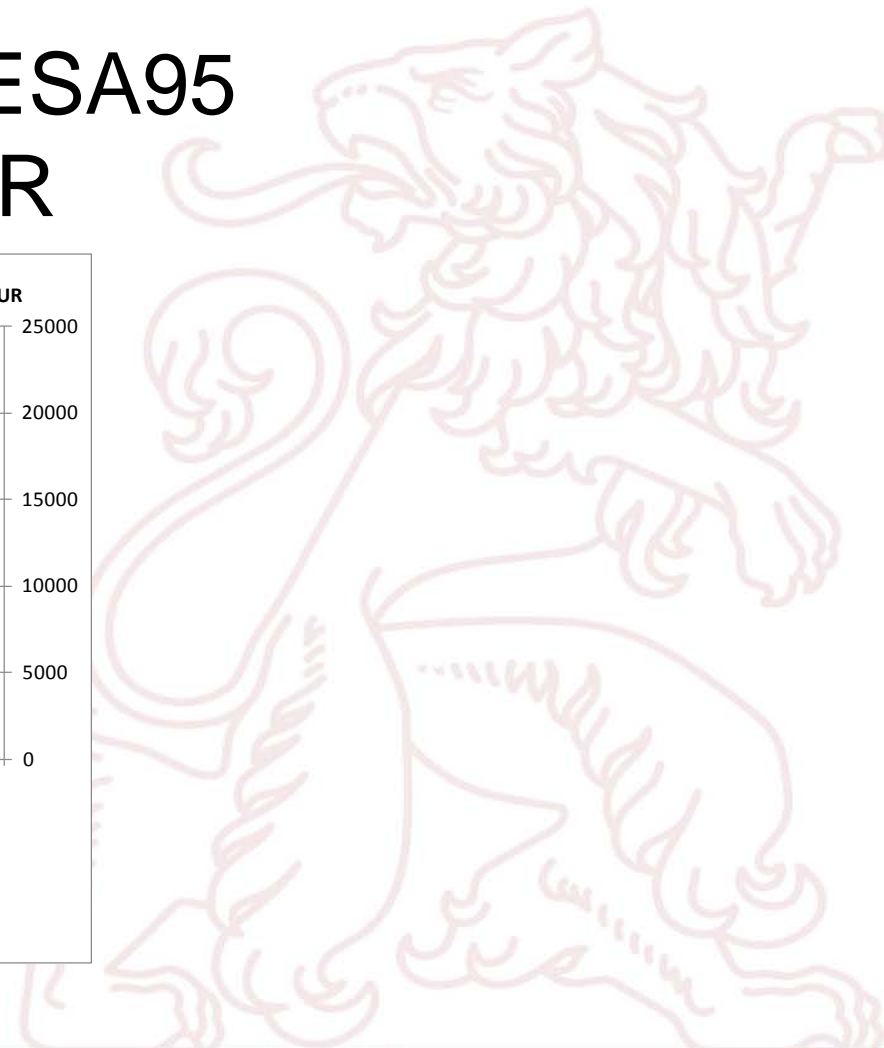


Data Source: Eurostat database

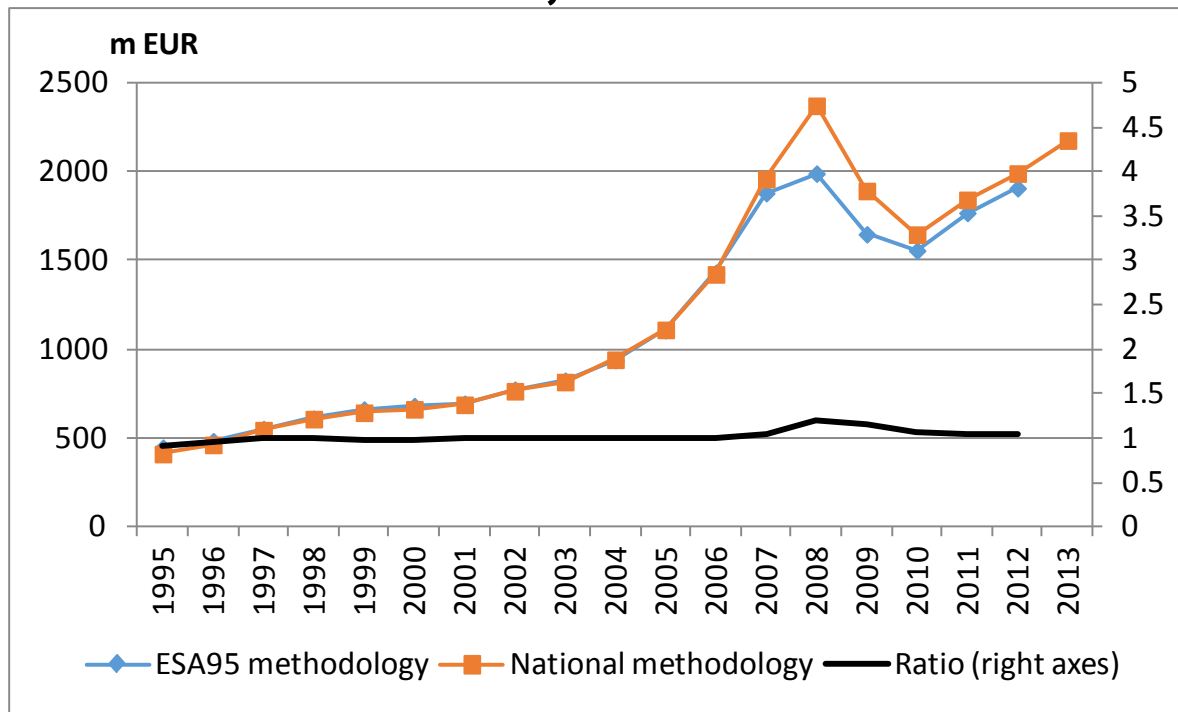
Tax Revenues in Latvia (ESA95 methodology), m EUR



Data Source: CSB database



Social Contributions in Latvia, m EUR

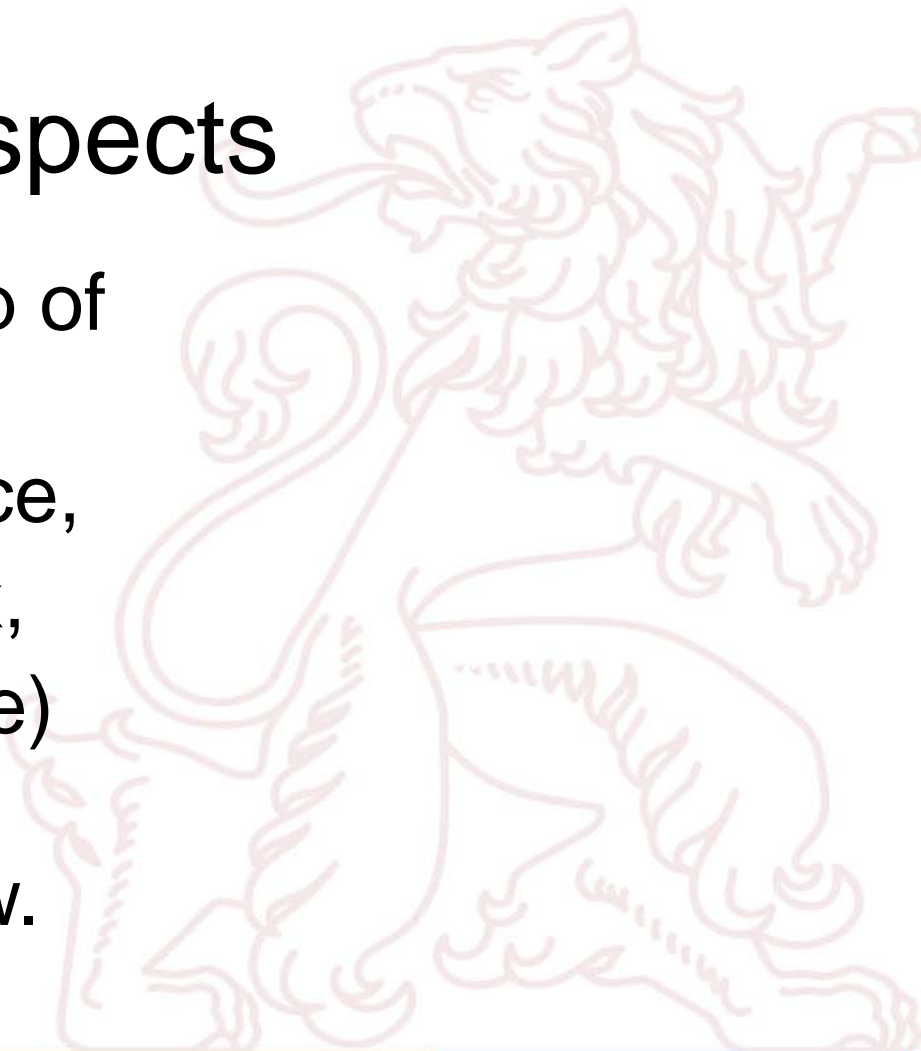


Data Source: CSB database, Ministry of Finance data

Analysis of Legal Aspects

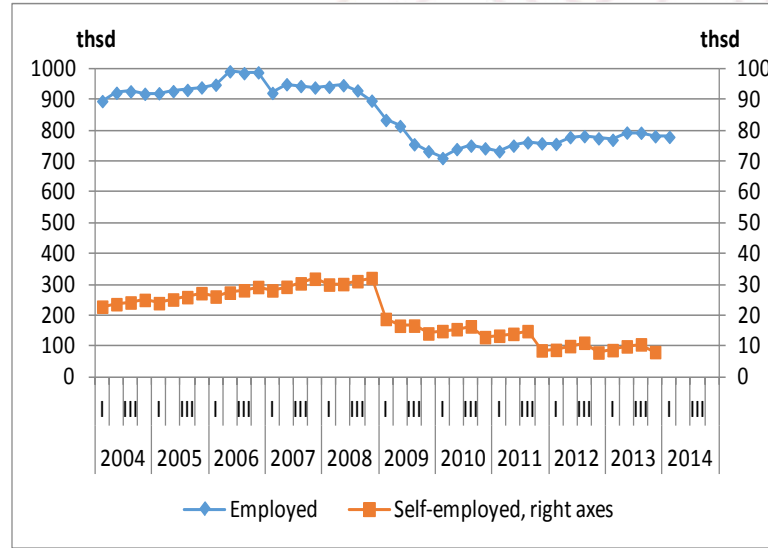
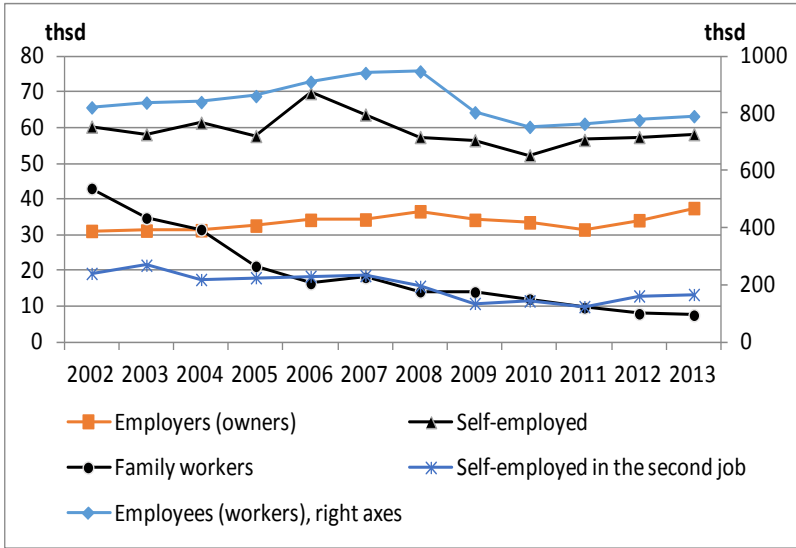
The main laws in the group of direct taxes are:

- On State Social Insurance,
- On Personal Income Tax,
- On Corporate (Enterprise) Income Tax,
- Micro-enterprise Tax Law.



Analysis of Legal Aspects

- Employed persons by professional status, thsd



Overall statistics (CSB)

Taxpayers (SRS)

Data Source: CSB database, State Revenue Service data

Analysis of Legal Aspects

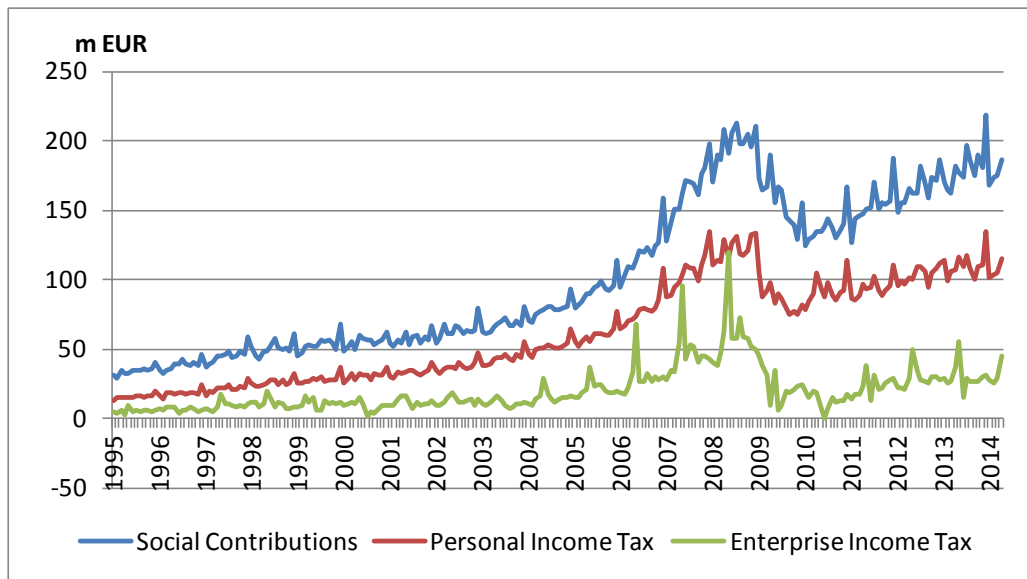
The main laws in the group of indirect taxes are:

- Value Added Tax Law (before 2013 law On Value Added Tax),
- On Excise Duty.



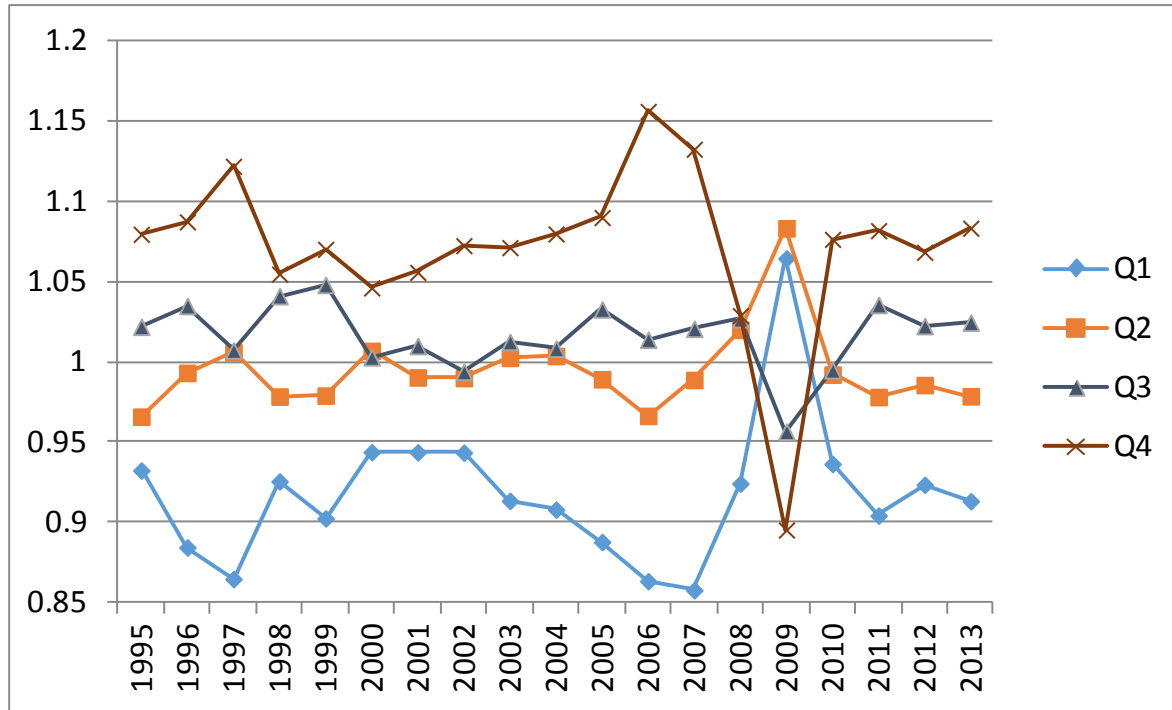
Seasonality Analysis

- Revenues of Direct Taxes, m EUR



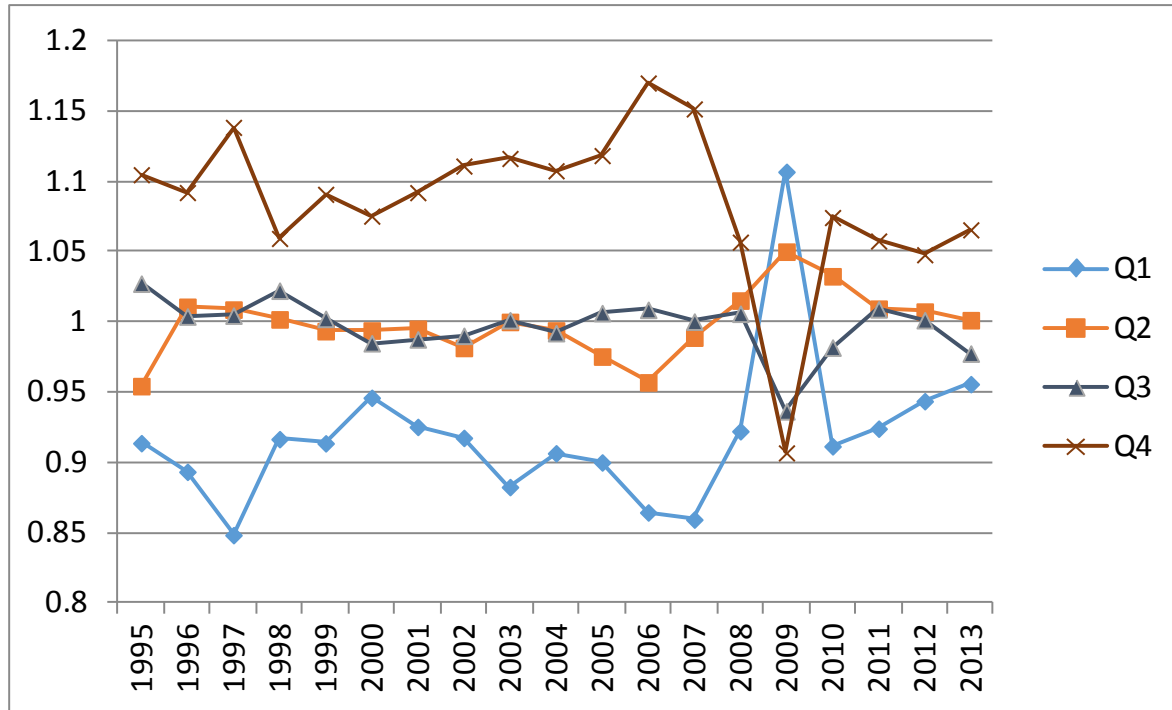
Data Source: Ministry of Finance data

Quarterly Seasonal Indexes for Social Contributions

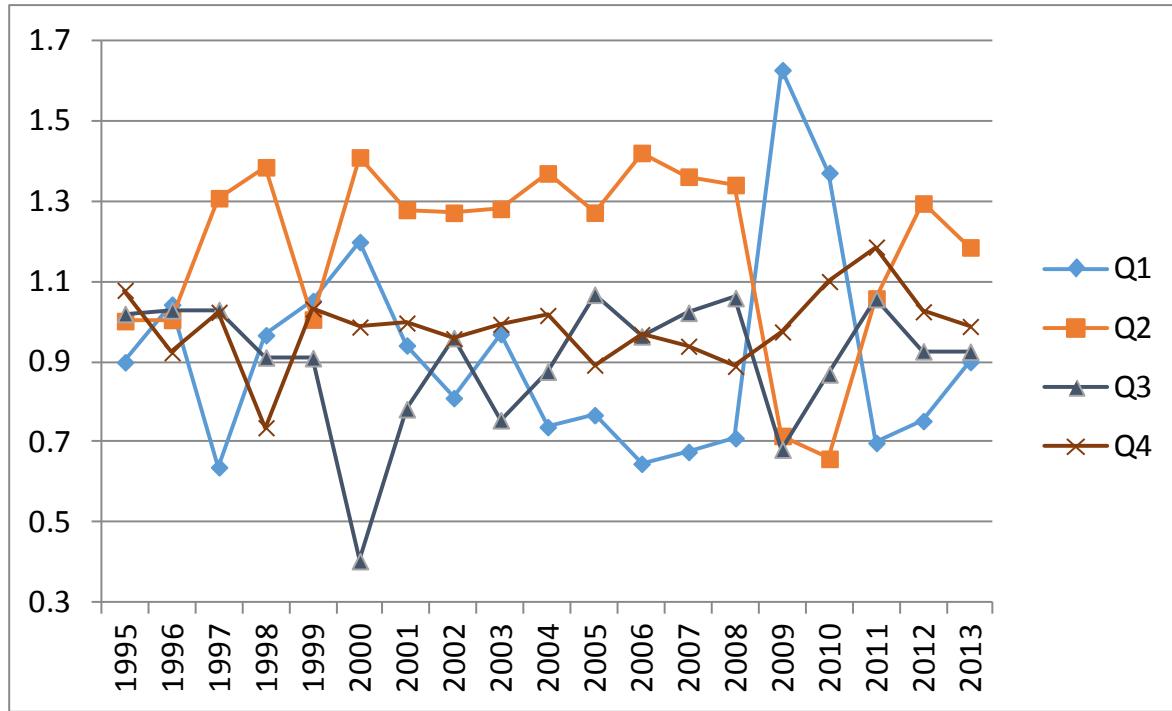


Data Source: Ministry of Finance data

Quarterly Seasonal Indexes for Personal Income Tax

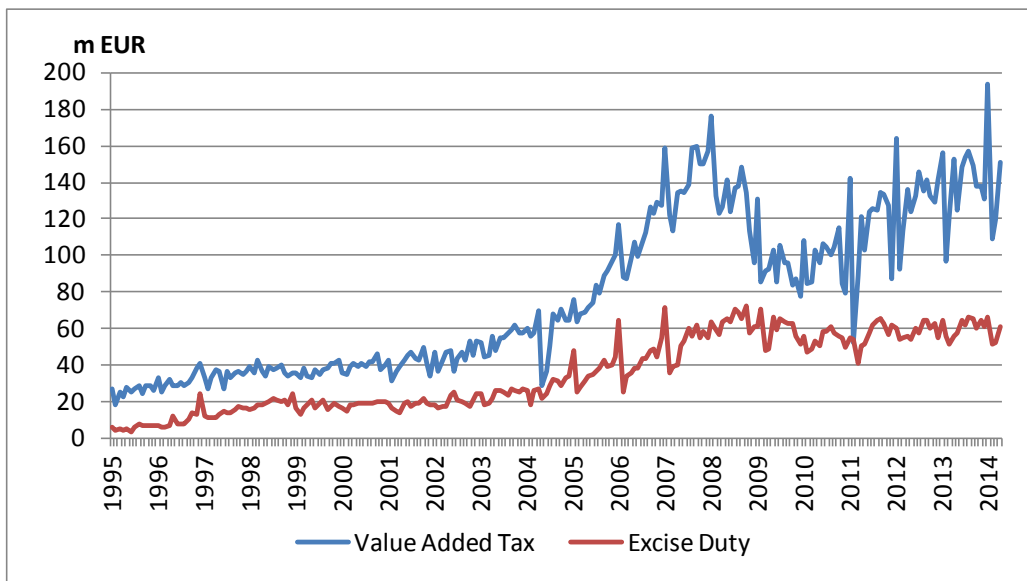


Quarterly Seasonal Indexes for Corporate Income Tax



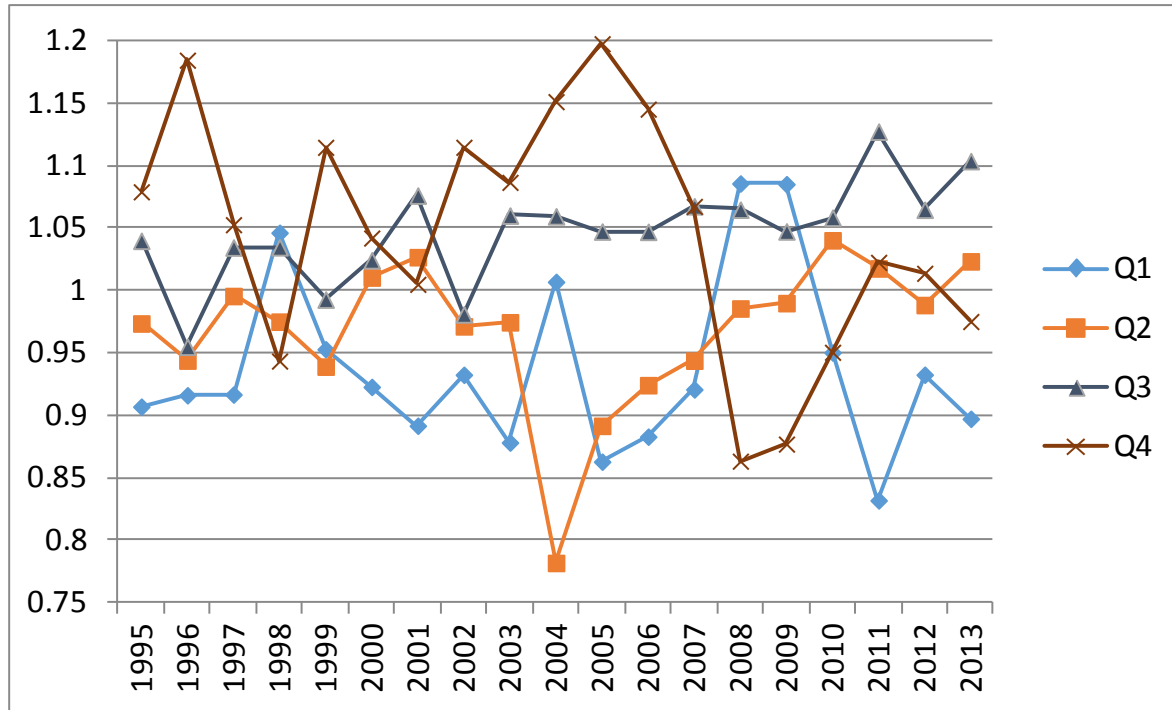
Seasonality Analysis

- Revenues of Indirect Taxes, m EUR



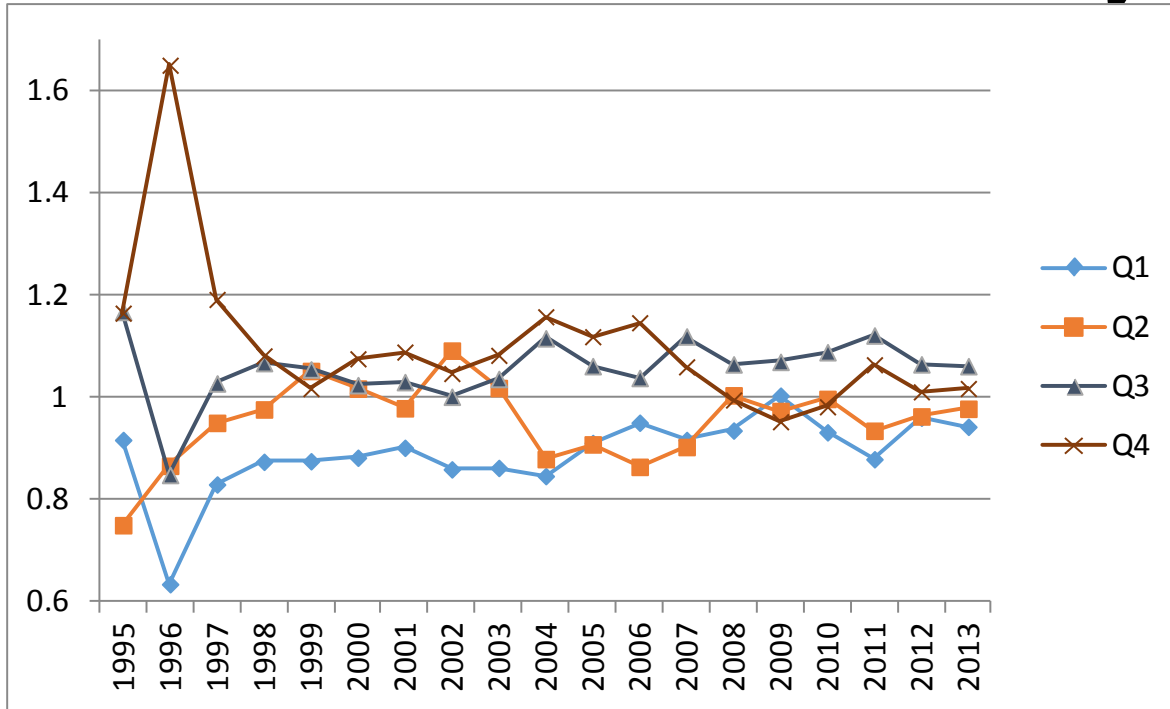
Data Source: Ministry of Finance data

Quarterly Seasonal Indexes for Value Added Tax



Data Source: Ministry of Finance data

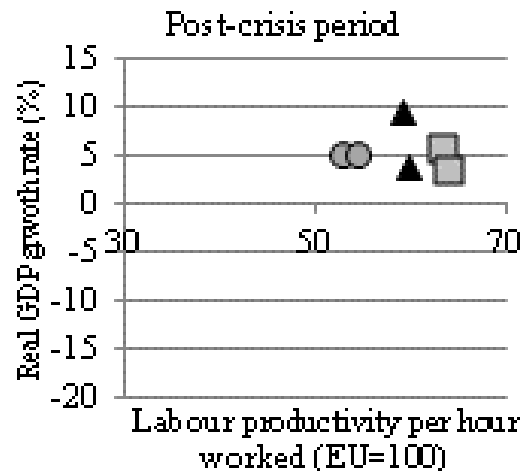
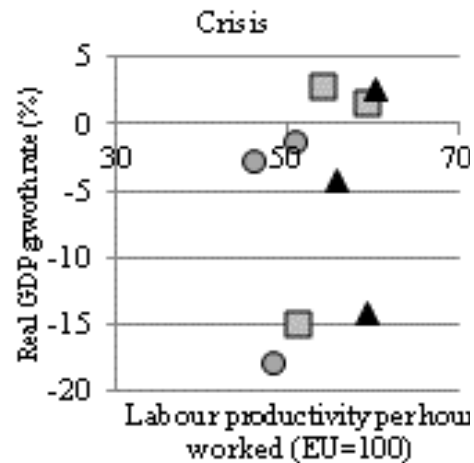
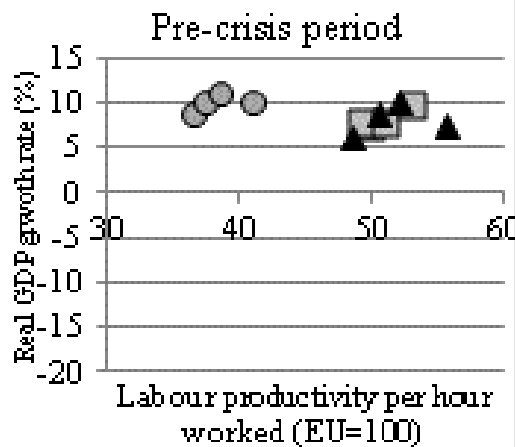
Quarterly Seasonal Indexes for Excise Duty



Data Source: Ministry of Finance data

Productivity and Economic Activity Analysis

- Labor productivity and real GDP growth rate (2004-2007) (2008-2010) (2011-2012)



● Latvia □ Lithuania ▲ Estonia

Methodology

- Modelling Approaches
- Models and Equations
 - Monthly
 - Quarterly
 - Annual



Monthly Data

- Seasonality Indexes
- Corporate Income Tax Revenues



Corporate Income Tax Revenues

- $$\text{CIT revenues} = \text{coef}_{\text{monthly}} * \text{CIT revenues}_{\text{lag}} * (1 + \text{PCI}_{\text{infl}}/100)/12 + \text{coef}_{\text{may}} * \text{PROF}_{\text{lag}}/100$$

where CIT revenues – corporate income tax revenues,

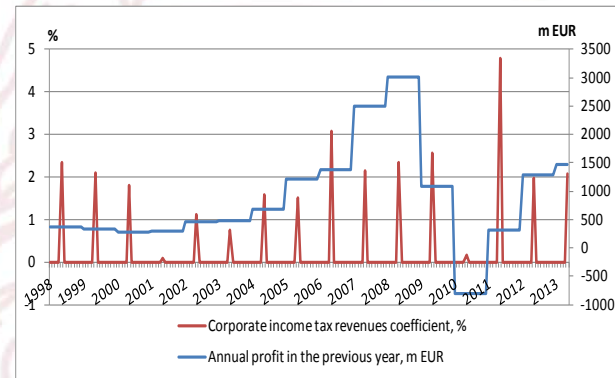
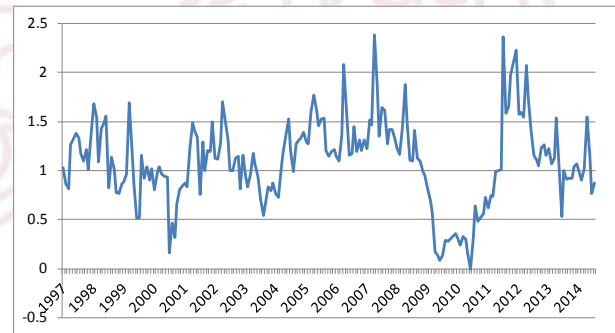
CIT revenues_{lag} – annual corporate income tax revenues with 17-month lag,

coef_{monthly} – corporate income tax advance payments coefficient,

PCI_{infl} – annual growth rate of private consumption price index in the previous year,

coef_{may} – corporate income tax revenues coefficient applied only in May,

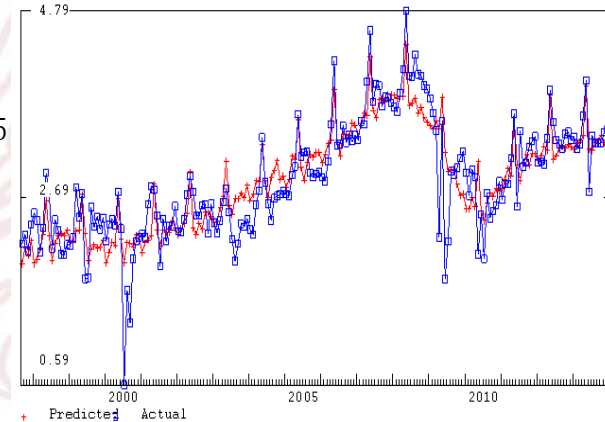
PROF_{lag} – annual profit in the previous year.



Corporate Income Tax Revenues

SEE = 0.32 RSQ = 0.7593 RHO = 0.45 Obser = 196 from 1997.009
 SEE+1 = 0.28 RBSQ = 0.7530 DW = 1.11 DoFree = 190 to 2013.012
 MAPE = 9.70

Variable name	Reg-Coeff	Mexval	Elas	NorRes	Mean	Beta
0 LTAX_UIN	---	---	---	---	2.89	---
1 intercept	5.45808	5.9	1.89	4.15	1.00	
2 @log(PCI[12])	-2.37844	18.5	-3.97	2.90	4.82	-0.904
3 @log(IM[12])	0.48841	2.1	1.03	1.47	6.09	0.467
4 @log(IM[6])	0.80975	7.9	1.72	1.26	6.15	0.761
5 D_5*@log(IM[6])	0.09099	11.2	0.02	1.04	0.51	0.241
6 @log(W_NOM[8]/PCI[8])	0.86536	1.8	0.31	1.00	1.05	0.375



Quarterly Data

- Identities
- Econometric Equations



Identities

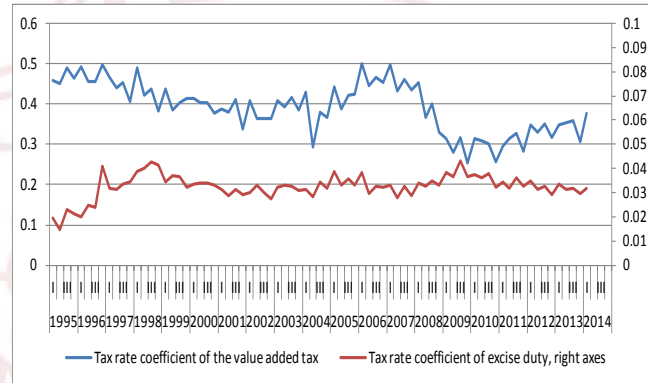
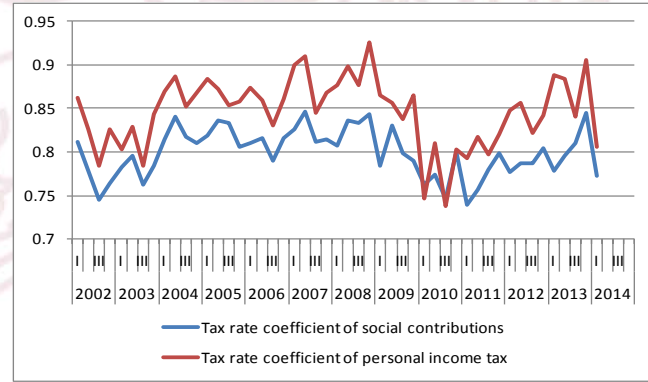
$$\text{tax_rev} = \text{taxr_coef} * \text{taxr} * \text{tax_base},$$

where tax_rev – tax revenues,

taxr_coef – tax rate coefficient,

taxr – tax rate,

tax_base – tax base.



Corporate Income Tax

$$\text{CIT revenues} = \text{coef}_q * \text{CIT revenues}_{\text{lag}} * (1 + \text{PCI}_{\text{infl}}/100)/12 + \text{coef}_{\text{II}} * \text{PROF}_{\text{lag}}/100,$$

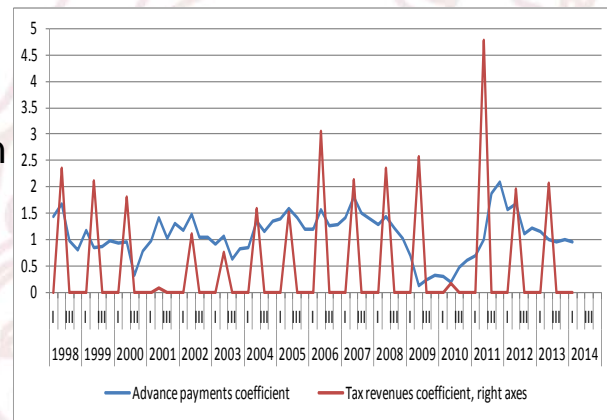
where CIT revenues – corporate income tax revenues,

CIT revenues_{lag} – annual corporate income tax revenues with 2-year lag (quarter 1), with 1-year lag (quarters 3 and 4) or weighted average of the 1-year and 2-year lag (quarter 2),

coef_q – corporate income tax advance payments coefficient,

PCI_{infl} – annual growth rate of private consumption price index in the previous year,

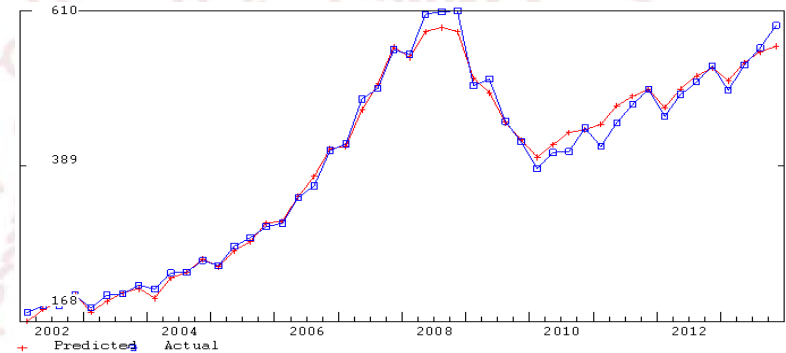
- coef_{II} – corporate income tax revenues coefficient applied only in the quarter 2,
- PROF_{lag} – annual profit in the previous year.



Social Contributions Revenues

SEE = 12.80 RSQ = 0.9911 RHO = 0.43 Obser = 48 from 2002.100
 SEE+1 = 11.82 RBSQ = 0.9907 DW = 1.14 DoFree = 45 to 2013.400
 MAPE = 2.39

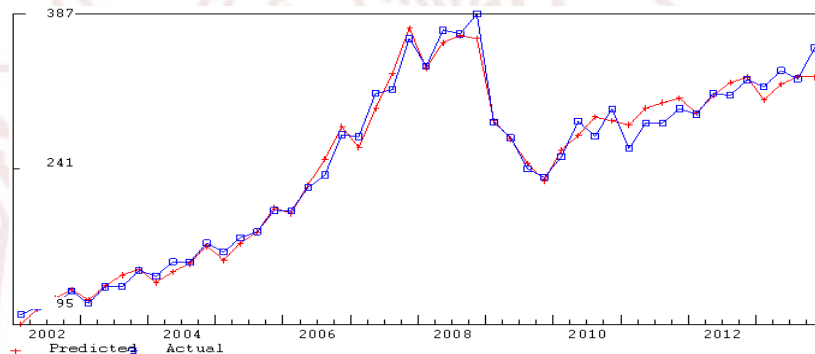
Variable name	Reg-Coeff	Mexval	Elas	NorRes	Mean	Beta
0 TAX_SOC	-----	-----	-----	-----	394.63	---
1 intercept	-15.67795	5.9	-0.04	112.06	1.00	
2 TAXR_SOC*((EMPL*W_NOM*3)/100000)	0.82441	929.9	1.03	1.22	492.62	1.007
3 D_EU	13.39648	10.3	0.01	1.00	0.31	0.046



Personal Income Tax Revenues

SEE = 10.34 RSQ = 0.9841 RHO = 0.14 Obser = 48 from 2002.100
 SEE+1 = 10.34 RBSQ = 0.9834 DW = 1.72 DoFree = 45 to 2013.400
 MAPE = 3.24

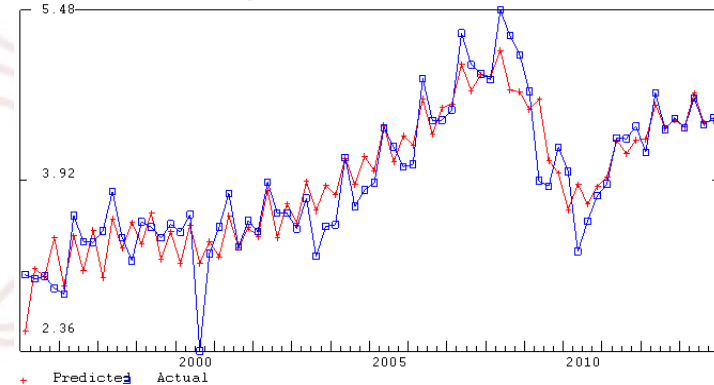
Variable name	Reg-Coef	Mexval	Elas	NorRes	Mean	Beta
0 TAX_INC_PERS	-----	-----	-----	-----	246.31	---
1 intercept	-15.42434	9.4	-0.06	62.85	1.00	
2 TAXR_IIN*((EMPL*(W_NOM-TAX_NMIN))/1000-TAX_SOC*TAX_SOC_E)	3.39666	687.7	1.08	2.44	78.20	1.022
3 D_10	-46.54480	56.2	-0.02	1.00	0.08	-0.157



Corporate Income Tax Revenues

SEE = 0.26 RSQ = 0.8398 RHO = 0.21 Obser = 72 from 1996.100
 SEE+1 = 0.25 RBSQ = 0.8303 DW = 1.58 DoFree = 67 to 2013.400
 MAPE = 5.23

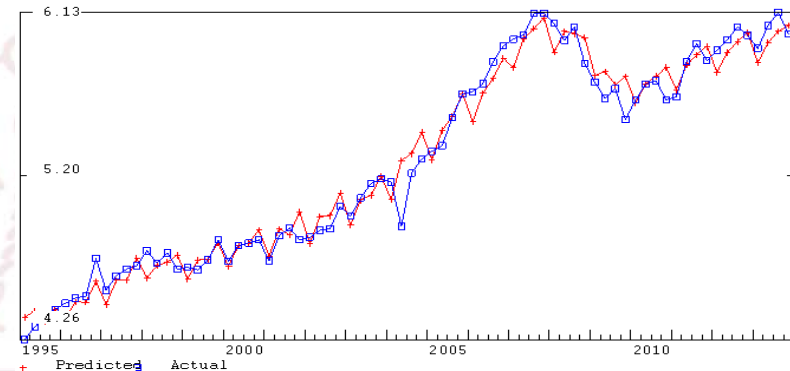
Variable name	Reg-Coeff	Mexval	Elas	NorRes	Mean	Beta
0 LTAX_INC_CORP	---	---	---	---	3.92	---
1 intercept	-8.75285	40.2	-2.23	6.24	1.00	
2 @log(PI_CONS_PR[4])	-2.03484	27.4	0.19	3.47	-0.36	-0.916
3 @log(IM_CP[4])	0.77342	6.9	1.43	1.45	7.26	0.817
4 @log(IM_CP[2])	0.85733	10.0	1.60	1.13	7.32	0.876
5 D_2*@log(INV_CP[1])	0.03463	6.4	0.01	1.00	1.58	0.150



Value Added Tax Revenues

SEE = 0.10 RSQ = 0.9723 RHO = 0.13 Obser = 76 from 1995.100
 SEE+1 = 0.09 RBSQ = 0.9712 DW = 1.74 DoFree = 72 to 2013.400
 MAPE = 1.37

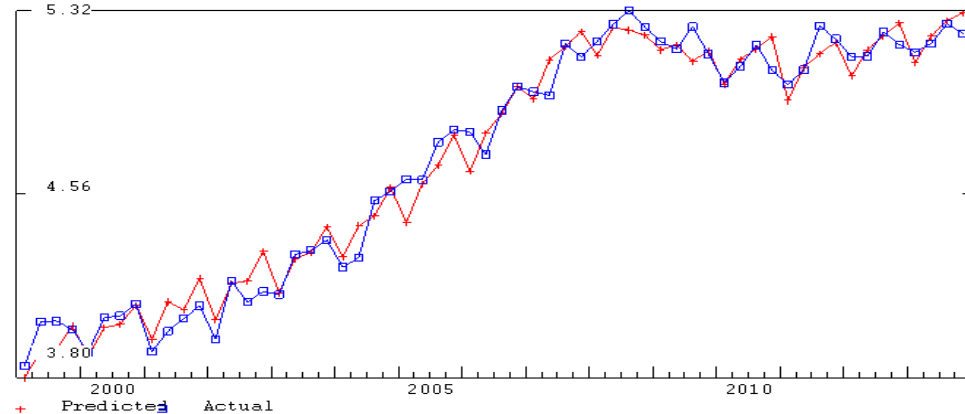
Variable name	Reg-Coeff	Mexval	Elas	NorRes	Mean	Beta
0 LTAX_VAT	-----	-----	-----	-----	5.27	---
1 intercept	-2.56866	55.4	-0.49	36.14	1.00	
2 @log(GDP_CP)	1.03000	201.5	1.54	1.28	7.89	1.094
3 @log(TIME)	-0.09040	6.8	-0.06	1.13	3.37	-0.143
4 D_EU	0.09103	6.5	0.00	1.00	0.20	0.063



Excise Duty Revenues

SEE = 0.08 RSQ = 0.9767 RHO = 0.06 Obser = 60 from 1999.100
 SEE+1 = 0.08 RBSQ = 0.9759 DW = 1.87 DoFree = 57 to 2013.400
 MAPE = 1.25

Variable name	Reg-Coeff	Mexval	Elas	NorRes	Mean	Beta
0 LTAX_EXC	---	---	---	---	4.70	---
1 intercept	-3.29918	170.7	-0.70	42.90	1.00	
2 @log(GDP_CP)	0.98389	514.3	1.70	1.39	8.11	0.958
3 D_0910	0.14311	17.7	0.00	1.00	0.13	0.098

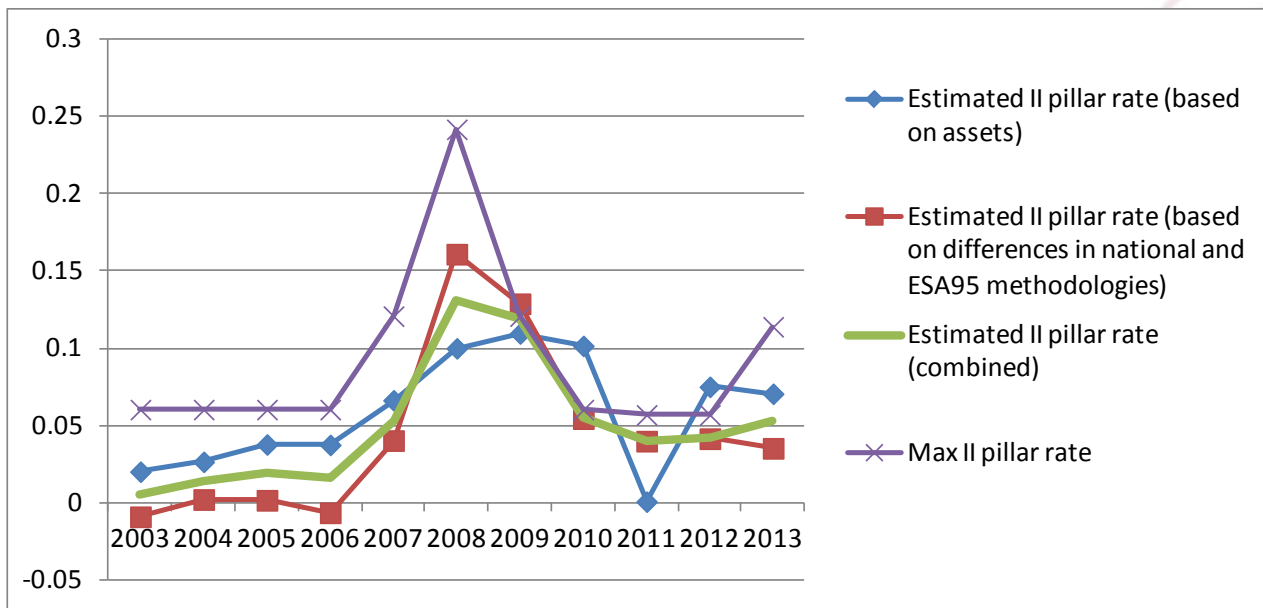


Annual Data

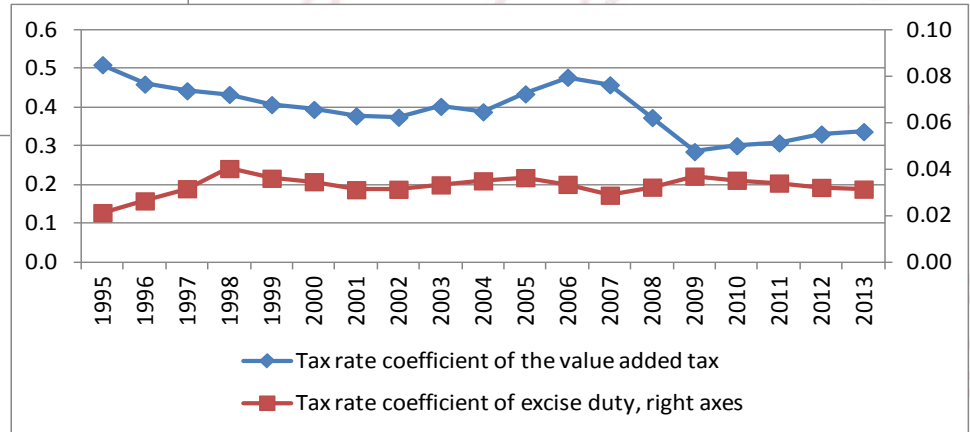
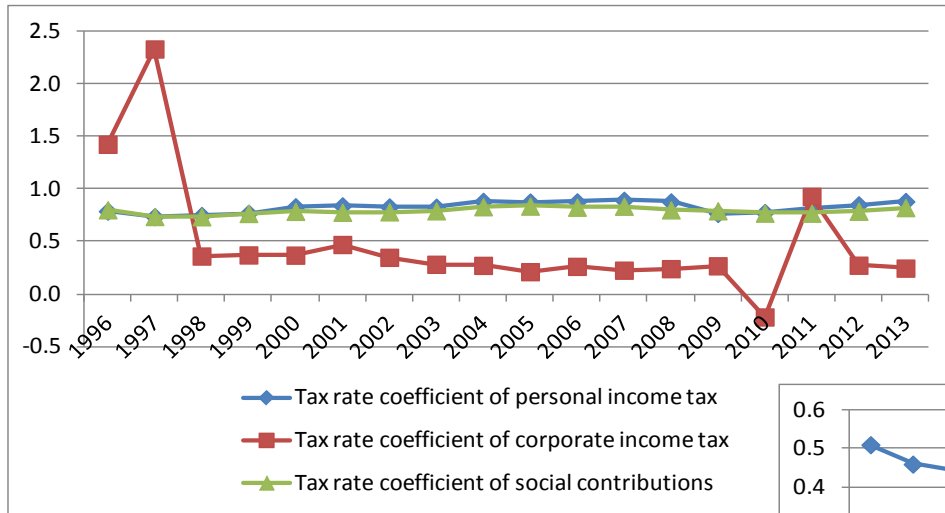
- Calculations in ESA95
- Identities
- Transformation Coefficients to forecast national data



Dynamics of Estimated II Pillar Rates in 2003-2013



Tax Rate Coefficients



Forecasts

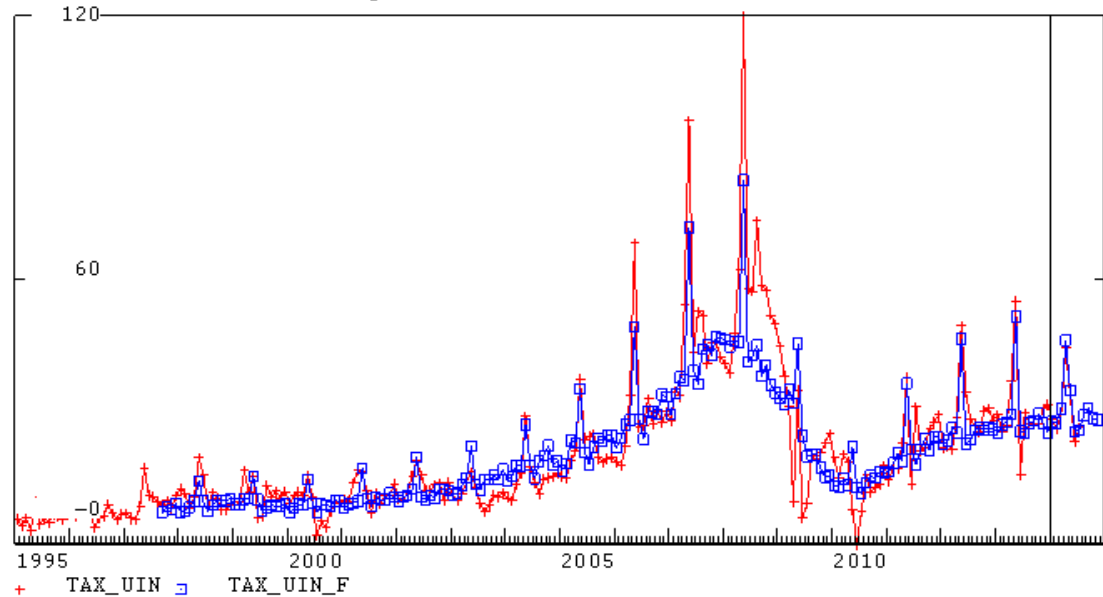
- Evaluation of precision
- Numbers



Corporate Income Tax (Monthly Data)

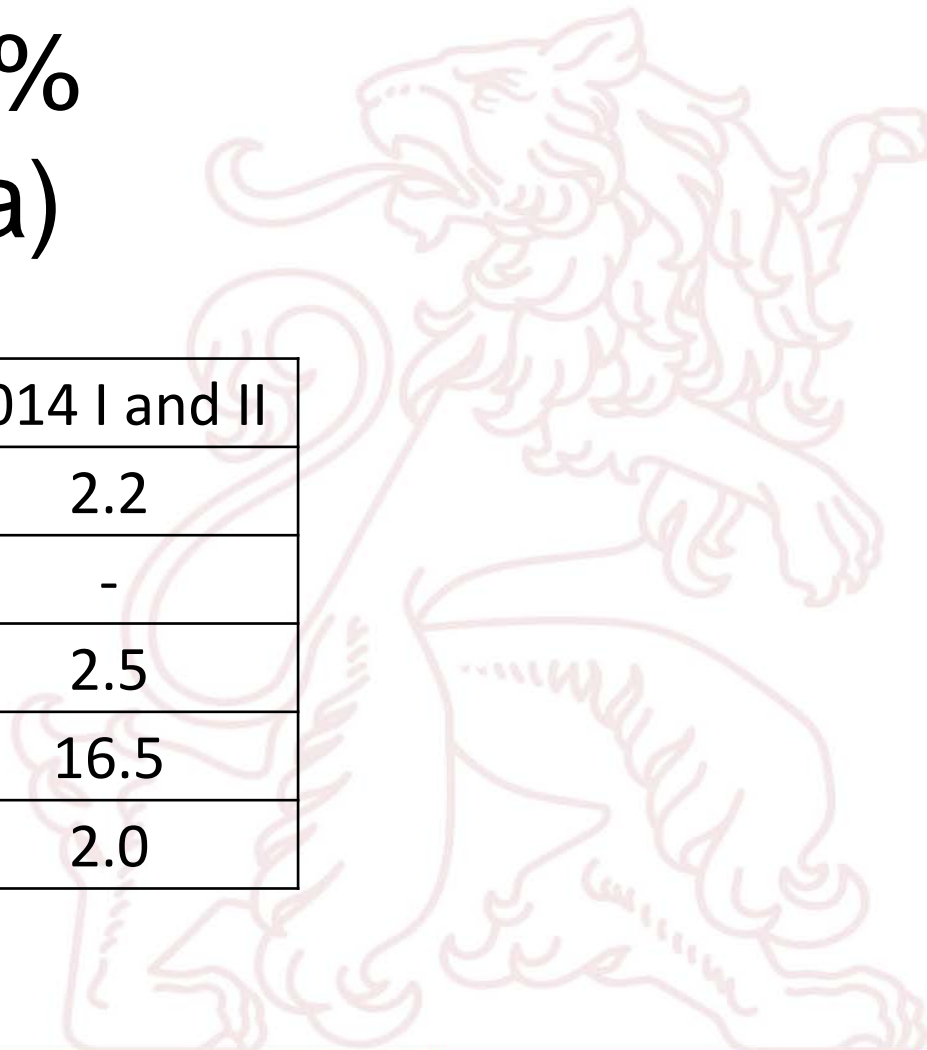
2014.001 – 2014.007

- MAPE = 14.3%
- Modified dummy MAPE = 3.6%



MAPE Values, % (Quarterly Data)

Tax Type	2014 I	2014 I and II
Social Contributions	3.7	2.2
Personal Income Tax	6.8	-
Corporate Income Tax	0.4	2.5
Value Added Tax	15.4	16.5
Excise Duty	0.7	2.0

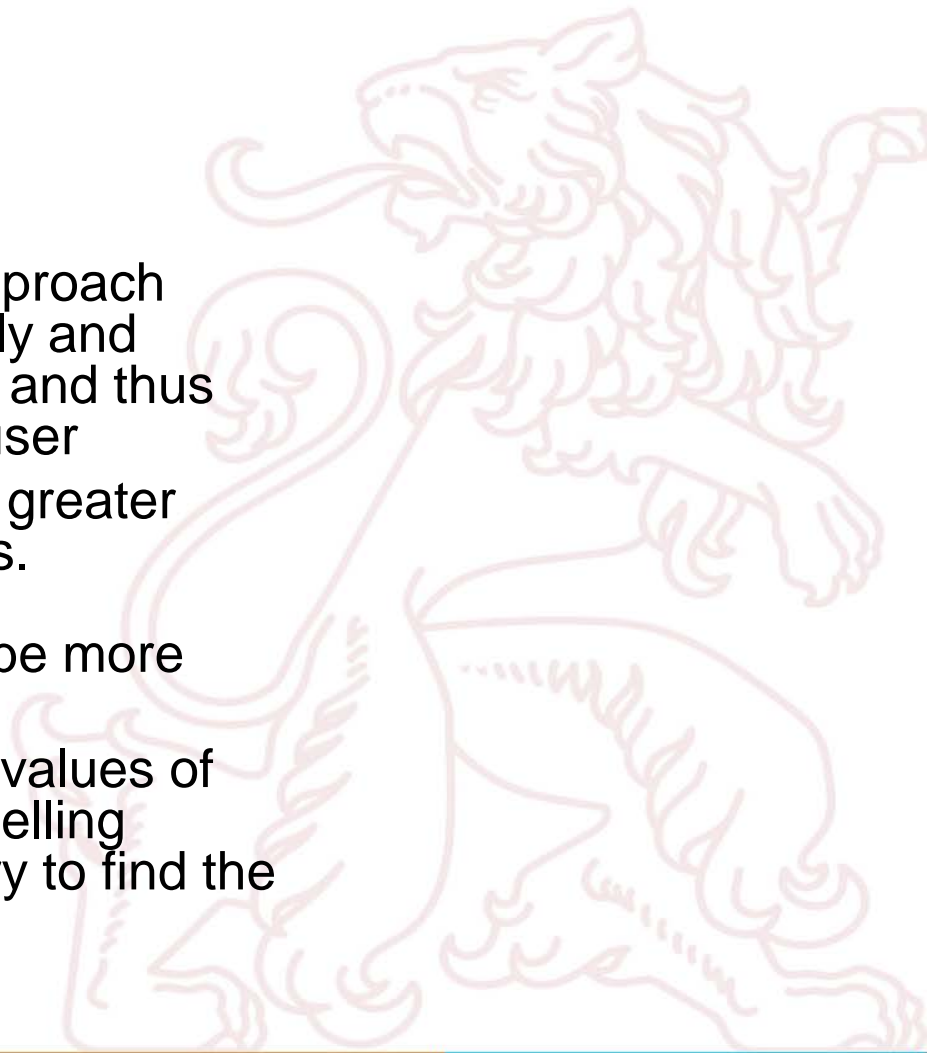


Comparison of Forecasts

Tax Type	Identity-based approach			Econometric equations	
	Monthly	Quarterly	Annual	Monthly	Quarterly
Social Contributions	-	2271.3	2139.6	-	2237.2
Personal Income Tax	-	1379.3	1415.1	-	1385.0
Corporate Income Tax	342.3	359.2	350.0	359.5	354.6
Value Added Tax	-	1885.1	1738.7	-	1638.5
Excise Duty	-	757.1	731.2	-	777.9

Conclusions

- Using annual data, identity-based approach should be preferred, however quarterly and monthly data can give similar results and thus the choice is in hands of the model-user
- Identity-based approach allows for a greater flexibility in scenario-building process. Econometric approach involves less assumptions and thus may seem to be more objective
- Forecasts depend very much on the values of exogenous indicators, therefore modelling approaches should be tested regularly to find the most reliable ones



LAIMA

- Latvian Interindustry Model (Aggregated/Annual)
- Goddess of destiny



Thank You for Attention

Questions?

