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)
Methodology

• Modelling Approaches
• Models and Equations
  – Monthly
  – Quarterly
  – Annual
Monthly Data

- Seasonality Indexes
- Corporate Income Tax Revenues
Corporate Income Tax Revenues

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

where 
- \( \text{CIT revenues} \) – corporate income tax revenues,
- \( \text{CIT revenues}_{\text{lag}} \) – annual corporate income tax revenues with 17-month lag,
- \( \text{coef}_{\text{monthly}} \) – corporate income tax advance payments coefficient,
- \( \text{PCI}_{\text{infl}} \) – annual growth rate of private consumption price index in the previous year,
- \( \text{coef}_{\text{may}} \) – corporate income tax revenues coefficient applied only in May,
- \( \text{PROF}_{\text{lag}} \) – annual profit in the previous year.
Corporate Income Tax Revenues

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Reg-Coef</th>
<th>Mexval</th>
<th>Elas</th>
<th>NorRes</th>
<th>Mean</th>
<th>Beta</th>
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</thead>
<tbody>
<tr>
<td>0 LTAX_UIN</td>
<td>- - - - - - - - - - - - - - - -</td>
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<tr>
<td>1 intercept</td>
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<td>2 @log(PCI[12])</td>
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<tr>
<td>3 @log(IM[12])</td>
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<td>2.1</td>
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<td>1.47</td>
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<td>4 @log(IM[6])</td>
<td>0.80975</td>
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<td>1.72</td>
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<td>6 @log(W_NOM[8]/PCI[8])</td>
<td>0.86536</td>
<td>1.8</td>
<td>0.31</td>
<td>1.00</td>
<td>1.05</td>
<td>0.375</td>
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</table>

![Graph showing predicted and actual data]
Quarterly Data

• Identities
• Econometric Equations
Identities

tax_rev = taxr_coef*taxr*tax_base,

where tax_rev – tax revenues,

taxr_coef – tax rate coefficient,

taxr – tax rate,

tax_base – tax base.
Corporate Income Tax

CIT revenues = \( \text{coef}_q \times \text{CIT revenues}_{\text{lag}} \times (1 + \frac{\text{PCI}_{\text{infl}}}{100})/12 + \)

\(+ \ \text{coef}_{II} \times \text{PROF}_{\text{lag}}/100, \)

where

- CIT revenues – corporate income tax revenues,
- CIT revenues\(_{\text{lag}}\) – 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),
- \(\text{coef}_q\) – corporate income tax advance payments coefficient,
- \(\text{PCI}_{\text{infl}}\) – annual growth rate of private consumption price index in the previous year,
- \(\text{coef}_{II}\) – corporate income tax revenues coefficient applied only in the quarter 2,
- \(\text{PROF}_{\text{lag}}\) – 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

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Reg-Coef</th>
<th>Mexval</th>
<th>Elas</th>
<th>NorRes</th>
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<td>2 TAXR_SOC*((EMPL<em>W_NOM</em>3)/100000)</td>
<td>0.82441</td>
<td>929.9</td>
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<td>1.22</td>
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<td>0.31</td>
<td>0.046</td>
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</table>
## Personal Income Tax Revenues

### Model Summary

\[
\text{SEE} = 10.34 \quad \text{RSQ} = 0.9841 \quad \text{RHO} = 0.14 \quad \text{Obser} = 48 \text{ from 2002.100}
\]

\[
\text{SEE+1} = 10.34 \quad \text{RBQS} = 0.9834 \quad \text{DW} = 1.72 \quad \text{DoFree} = 45 \text{ to 2013.400}
\]

\[
\text{MAPE} = 3.24
\]

### Variable Coefficients

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Reg-Coef</th>
<th>Mexval</th>
<th>Elas</th>
<th>NorRes</th>
<th>Mean</th>
<th>Beta</th>
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<td>9.4</td>
<td>-0.06</td>
<td>62.85</td>
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<td>0.00</td>
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<tr>
<td>2 TAXR_IIN*((EMPL*(W_NOM-TAX_NMIN))/1000-TAX_SOC*TAX_SOC_E)</td>
<td>3.39666</td>
<td>687.7</td>
<td>1.08</td>
<td>2.44</td>
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<td>-0.02</td>
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<td>-0.157</td>
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</table>

![Graph showing predicted versus actual income tax revenues from 2002 to 2013]
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

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<th>Reg-Coef</th>
<th>Mexval</th>
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<td>2 @log(PI_CONS_PR[4])</td>
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<td>3 @log(IM_CP[4])</td>
<td>0.77342</td>
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<td>5 D_2*@log(INV_CP[1])</td>
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<td>0.01</td>
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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

<table>
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<th>Variable name</th>
<th>Reg-Coef</th>
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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

<table>
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Annual Data

• Calculations in ESA95
• Identities
• Transformation Coefficients to forecast national data
Dynamics of Estimated II Pillar Rates in 2003-2013
Tax Rate Coefficients

- Tax rate coefficient of personal income tax
- Tax rate coefficient of corporate income tax
- Tax rate coefficient of social contributions
- Tax rate coefficient of the value added tax
- Tax rate coefficient of excise duty, right axes
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)

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<tr>
<th>Tax Type</th>
<th>2014 I</th>
<th>2014 I and II</th>
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<td>Social Contributions</td>
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<td>2.2</td>
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<tr>
<td>Personal Income Tax</td>
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<tr>
<td>Corporate Income Tax</td>
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<tr>
<td>Value Added Tax</td>
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<td>16.5</td>
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<tr>
<td>Excise Duty</td>
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<td>2.0</td>
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## Comparison of Forecasts

<table>
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<tr>
<th>Tax Type</th>
<th>Identity-based approach</th>
<th>Econometric equations</th>
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<td>Quarterly</td>
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<td>Excise Duty</td>
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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?