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Ministerstvo financií SR / www.finance.gov.sk/ifp

Stochastic forecast of the Slovak public debt

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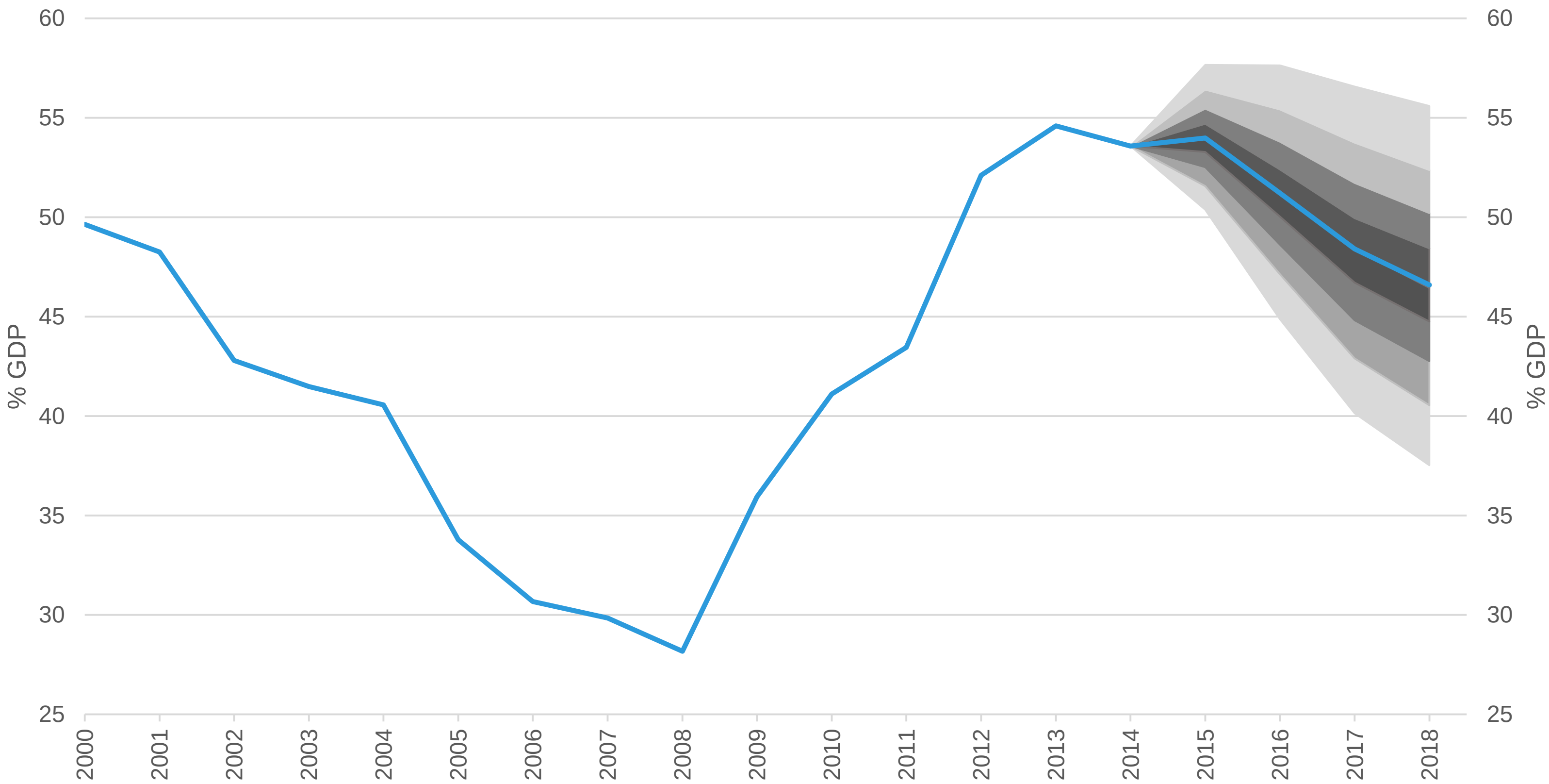


outline

- why we do it
- how we do it
- what we have got

why we do it

- standard practice
  - deterministic projection
  - contains all available information
- stochastic forecast – 2 in 1
  - independent, model-based, forecast
  - quantification of uncertainty
- benefits
  - credibility – transparent & free of judgements / interventions
  - expanding the set of communication tools – quantification of uncertainty
- limitations
  - blunt instrument – no room for external information

forecast

- debt (any variable) <u>ex ante</u>: $Y_{t|t-1} = A * Y_{t-1}$
  - deterministic forecast
- debt (any variable) <u>ex post</u>: $Y_t = A * Y_{t-1} + u_t \neq Y_{t|t-1}$
  - complex environment
  - realization of unforeseen events
- debt (any variable) <u>ex ante</u>: $Y_{t|t-1} = A * Y_{t-1} + e_t$
  - stochastic forecast
  - cannot forecast unforeseen events – stochastic component
  - want to estimate probability distribution of the stochastic component
  - generate a large number of shock trajectories from the estimated distribution

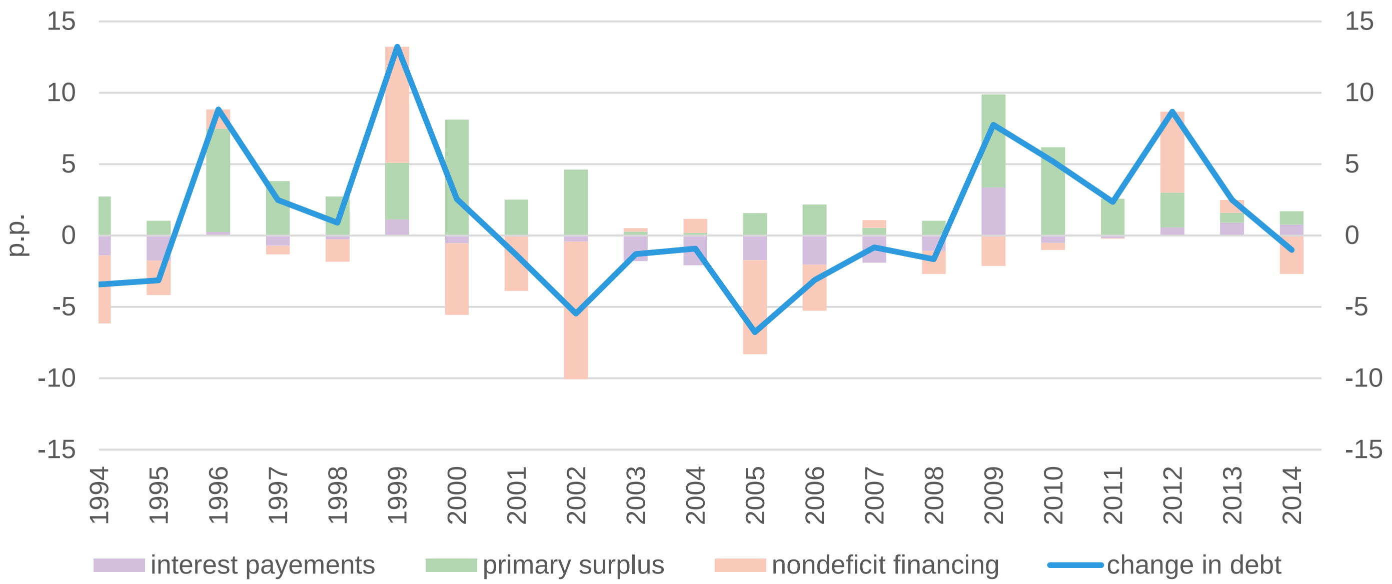
how we do it

$$d_t = \frac{1+i_t}{(1+g_t)(1+p_t)} d_{t-1} - ps_t + nondeffin_t$$

- indirect approach, Medeiros (2012)
  - simulate a large number of random trajectories of individual components of the debt equation (relative to GDP)

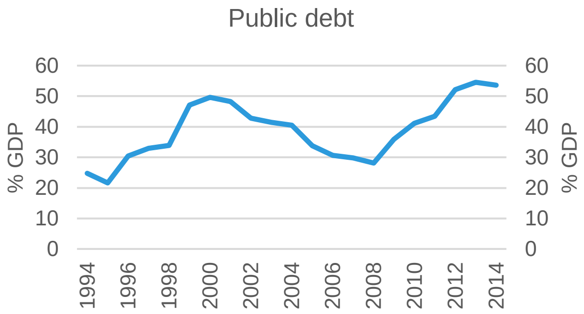
- need to simulate:
  - interest rates
  - primary surplus
  - non-deficit (exogenous) financing
  - growth of real GDP
  - inflation in price of GDP

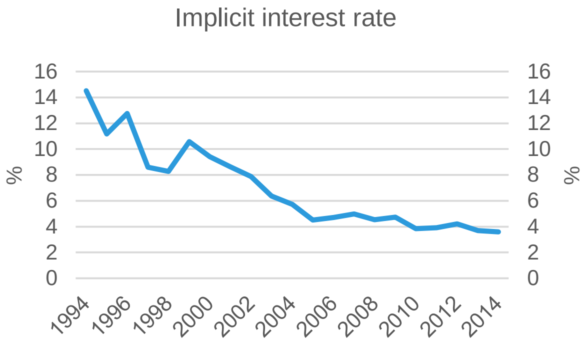
background: decomposition of the debt growth

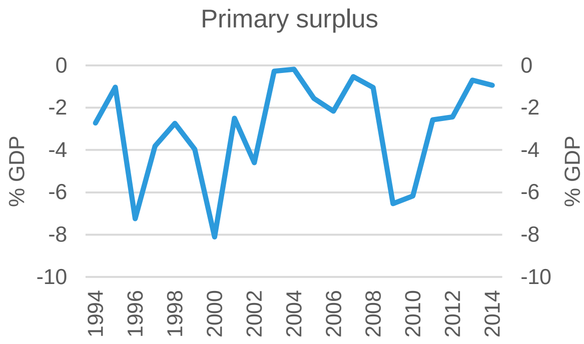


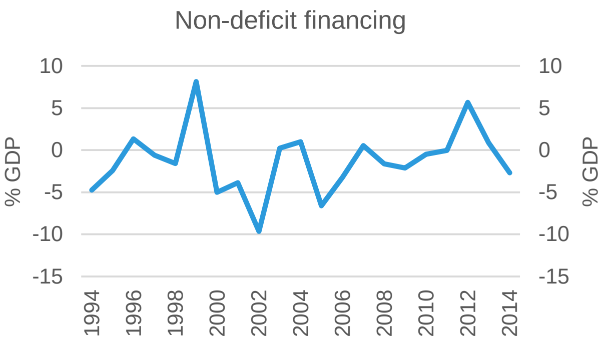
$$d_t - d_{t-1} = \frac{i_t - g_t - p_t}{(1+g_t)(1+p_t)} d_{t-1} - ps_t + nondeffin_t$$

data


Public debt
60
50
40
30
20
10
0
% GDP
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


Implicit interest rate
16
14
12
10
8
6
4
2
0
%
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


Primary surplus
0
-2
-4
-6
-8
-10
% GDP
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


Non-deficit financing
10
5
0
-5
-10
-15
% GDP
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

algorithm

- 3-step method
- step 1:
  - growth of GDP
  - GDP inflation
  - interest rates on debt
- step 2:
  - exogenous financing
- step 3:
  - primary surplus
  - debt

algorithm: step 1

- macro VAR model of a small open economy
  - parsimonious model:
    - growth of real GDP (SK, EU)
    - GDP inflation (SK, EU)
    - government bond yields (SK, EU)
    - NEER

  - quarterly data
  - estimated VAR(3)
  - get variance-covariance matrix of residuals
  - simulate *n* random trajectories (convert to annual frequency)

algorithm: step 1 cont.

- interest rates: government bond yields vs rates on debt
  - bond yields – VAR output
  - rates on debt – return on portfolio
  - combination of historic data, yields on newly issued bonds and average portfolio maturity

$$i_t = i_{t-1} * (1 - \frac{1}{am_t}) + \frac{1}{am_t} * ig_t$$

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algorithm: step 2

- exogenous financing component - optional
  - independent of other model ingredients
  - average value in the past ≈ 0
  - i.i.d. process
  - generate *n* random trajectories from $N(0,\sigma^2)$

algorithm: step 3

- primary surplus & debt simultaneously
  - fiscal reaction function & debt equation
  - use outcome of step 1 & step 2
  - iterative process: $d_{t-1} \rightarrow ps_t \rightarrow d_t$ ...

$$ps_t = a_0 + a_1 * d_{t-1} + a_2 * gap_t + \mathcal{E}_t$$

$$d_t = \frac{1+i_t}{(1+g_t)(1+p_t)} d_{t-1} - ps_t + nondeffin_t$$

  - simulate *n* stochastic paths

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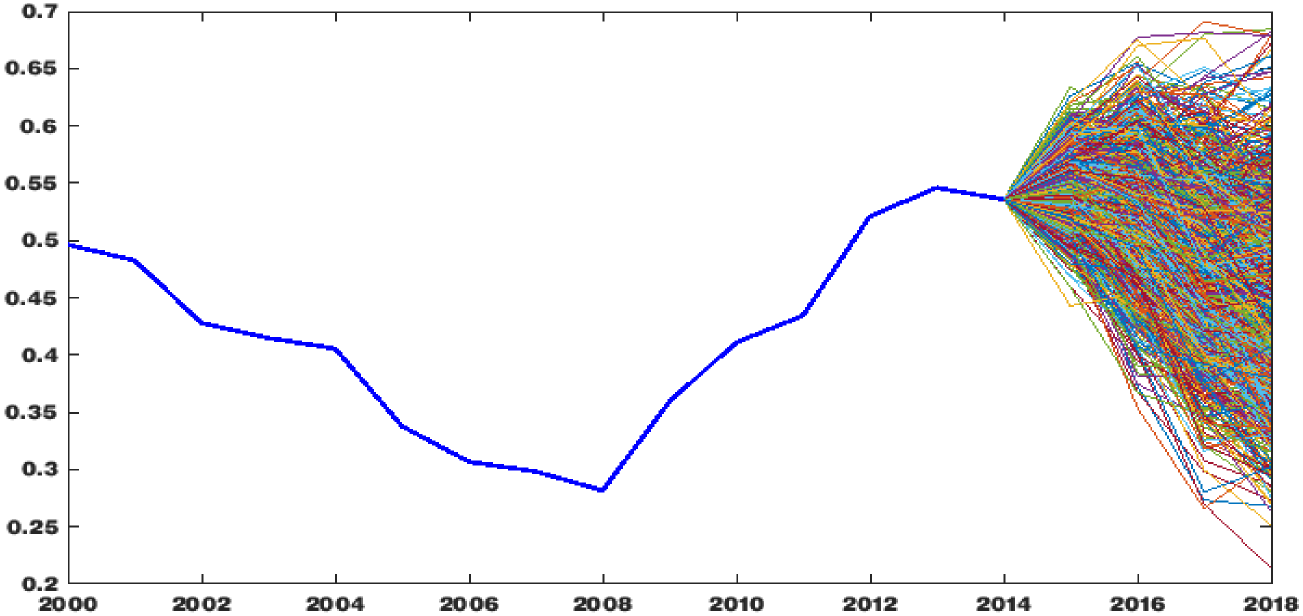
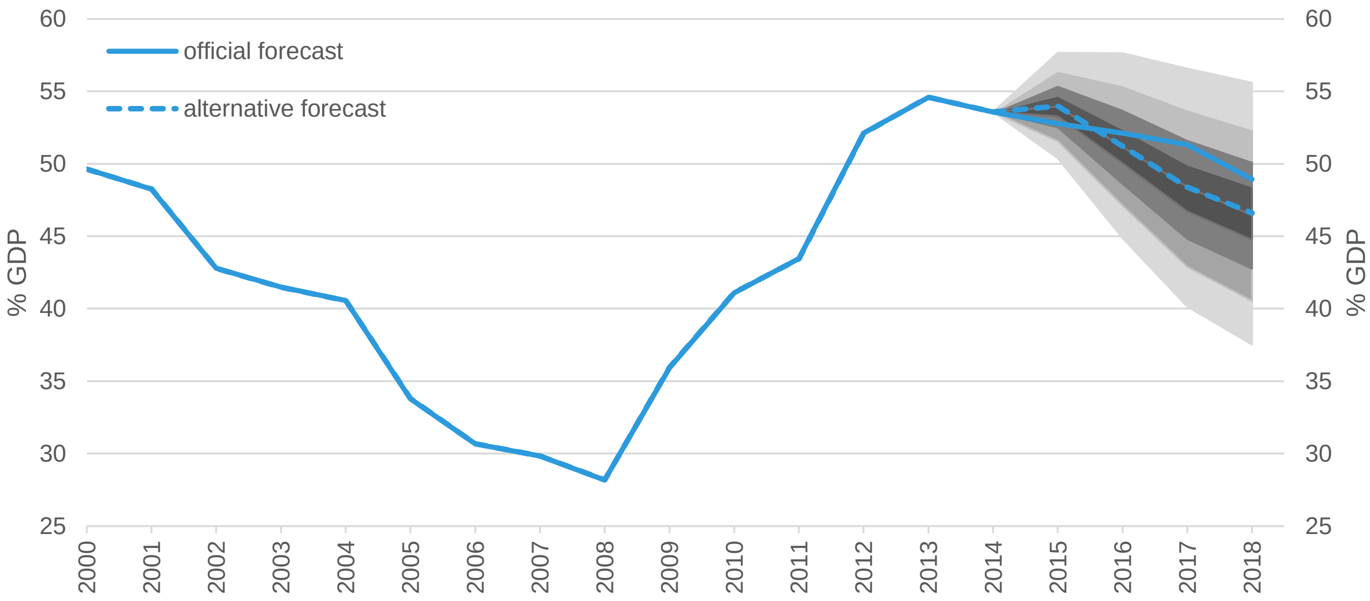
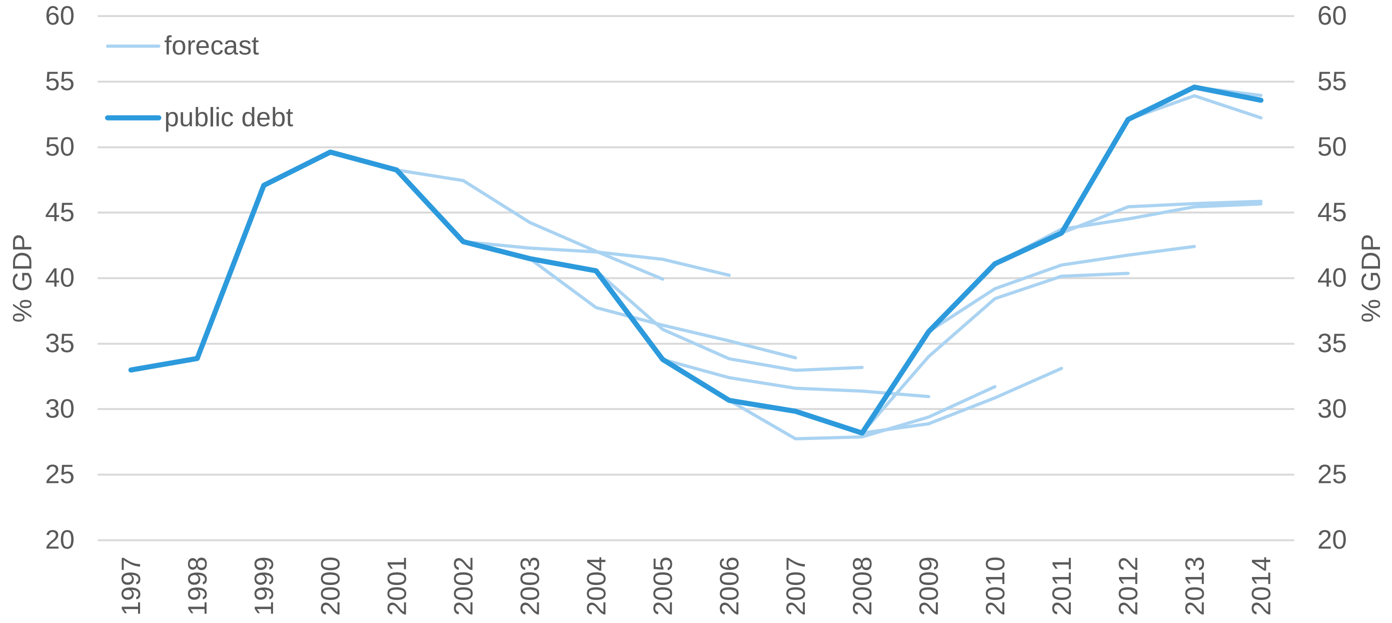
fan-chart: backstage



fan-chart


official forecast
alternative forecast
% GDP
% GDP
60
55
50
45
40
35
30
25
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

performance of the model, in-sample



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thank you