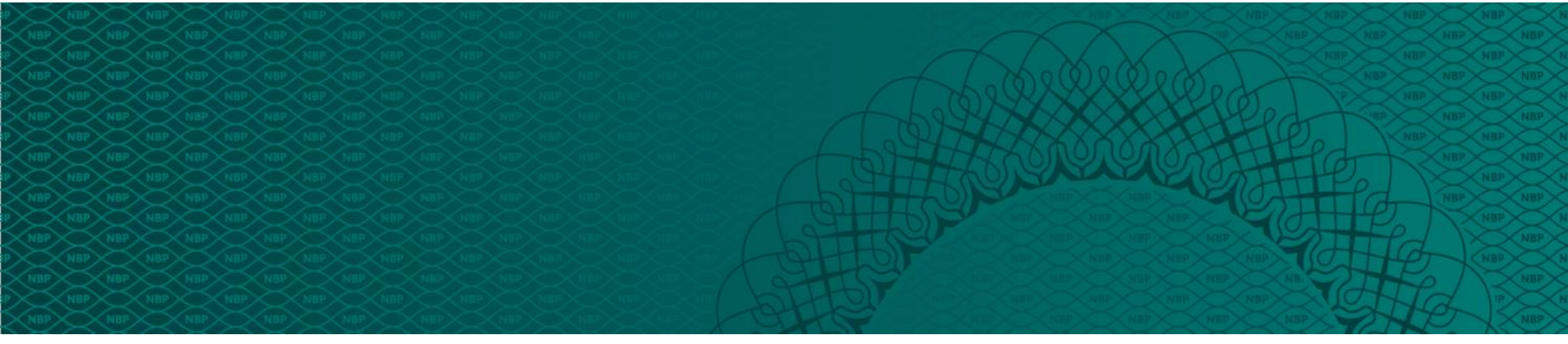
NBP Narodowy Bank Polski

Oskar Krzesicki (NBP) and Marcin Borsuk (NBP/UG)

NBP stress testing satellite models

15 September 2017



Agenda

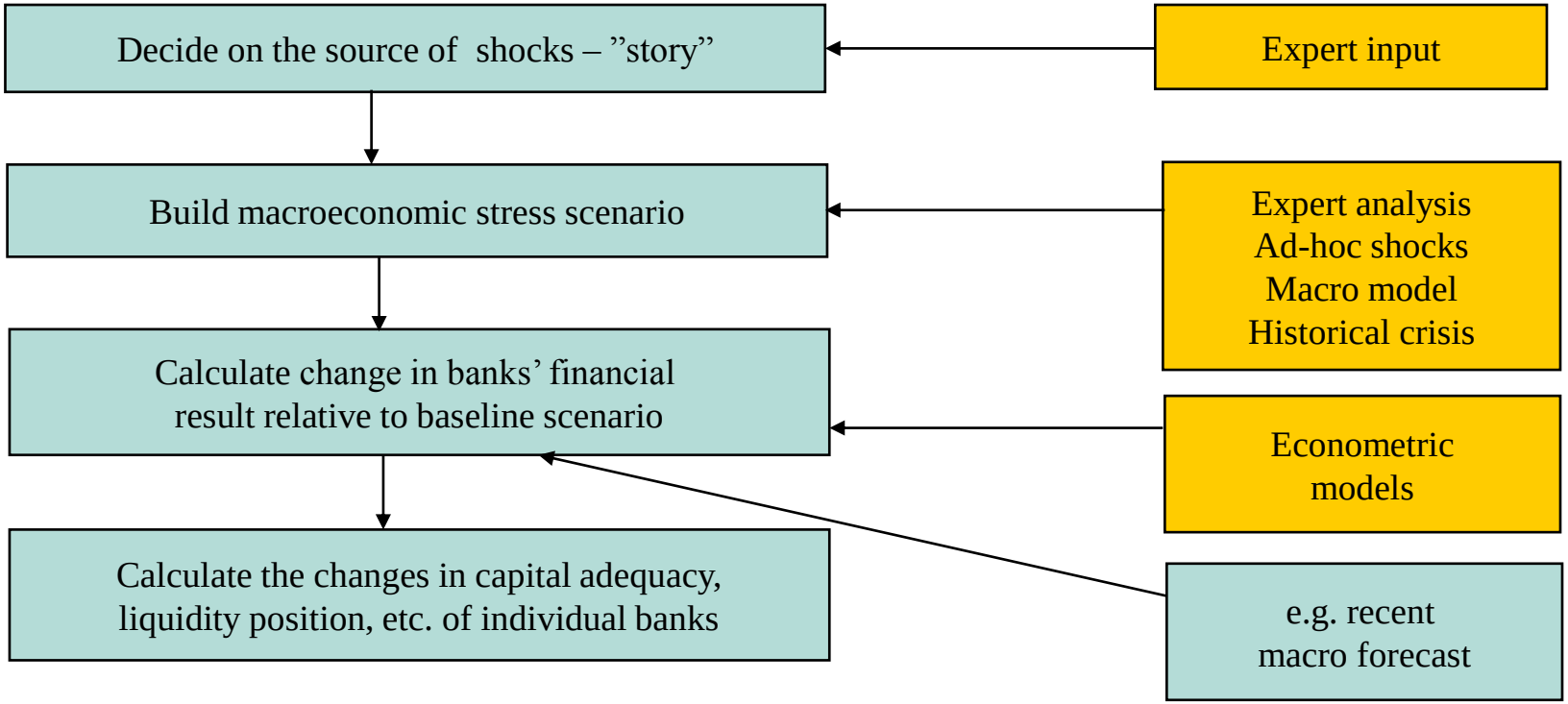
- Introduction – definitions and framework
- Scenarios and macro-financial assumptions
- Satellite panel models of credit risk and (net) interest margin

Introduction – definitions and framework

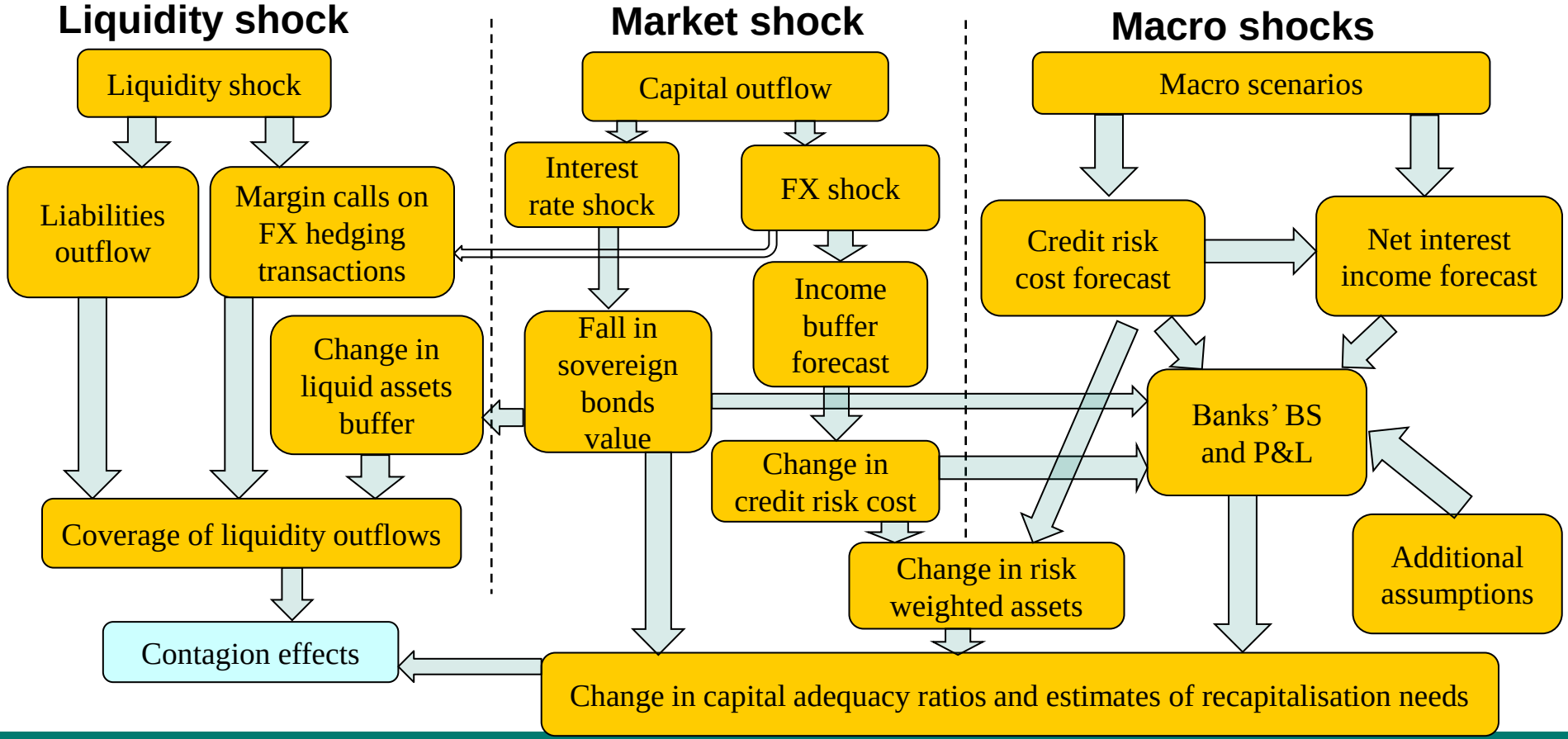
Some definitions

- A macro stress test (MST) is a rough quantitative evaluation of the resilience of a financial system to large but plausible shocks (low probability, high impact events)
- Sensitivity vs. scenario analysis
  - sensitivity – a single indicator (macro variable or FSI) is shocked
  - scenario – coherent changes in multiple variables, for example projection from macro model or historical data
- Top-down (”in-house”) vs. bottom-up (calculations performed by financial institutions based on assumptions provided by supervisory authority)

Constructing a macro stress test



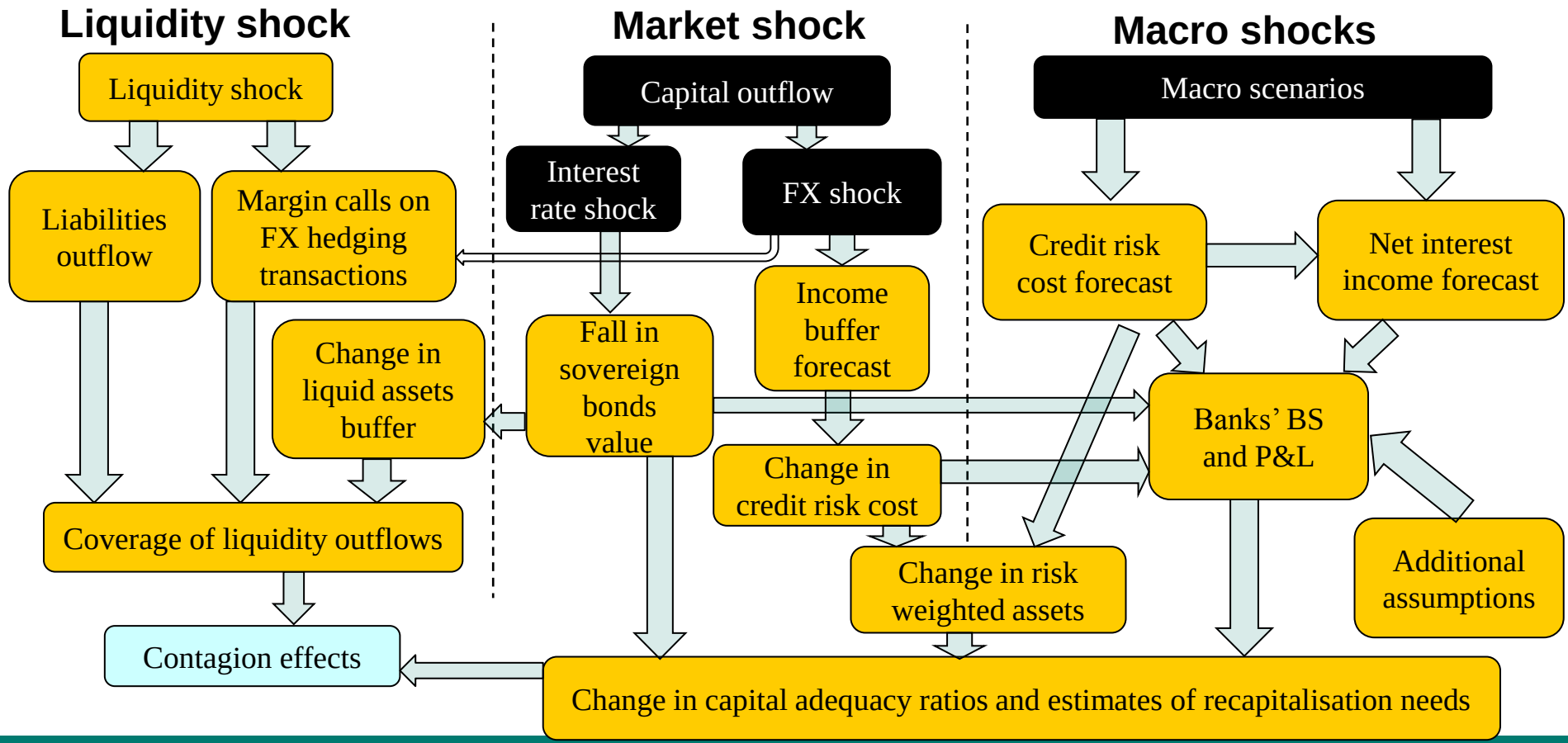
Macro stress-testing at the NBP – building blocks



Solvency macro stress testing at the NBP

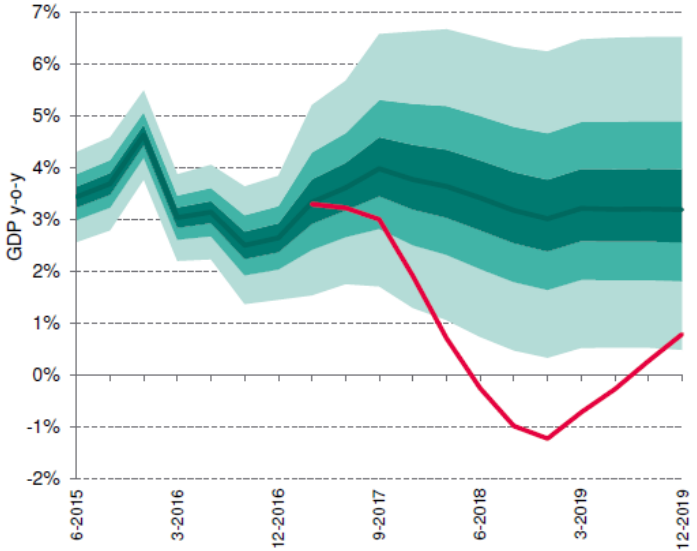
- Top-down stress test for domestically incorporated commercial banks:
  - 35 commercial banks (BGK excluded) – above 80% of the banking sector by assets
  - Polish banking sector is composed of domestically incorporated commercial banks, 27 branches of credit institutions (2%) and 554 cooperative banks (7%)
- Simulations for individual banks on solo basis
- Usually performed twice a year, aggregate results published in the FSR
  - additional stress tests – for example if requested by the NBP management board
- Since 2013: cooperation with the supervisory authority
  - same scenarios used for top-down tests of the NBP and bottom-up tests of the PFSA or…
  - NBP performs top-down stress tests for PFSA as a reference for bottom-up exercises (like the European stress-test)
  - discussion on results

Scenarios and macro-financial assumptions


Liquidity shock
Market shock
Macro shocks
Liquidity shock
Capital outflow
Macro scenarios
Liabilities outflow
Margin calls on FX hedging transactions
Interest rate shock
FX shock
Credit risk cost forecast
Net interest income forecast
Income buffer forecast
Change in liquid assets buffer
Fall in sovereign bonds value
Banks' BS and P&L
Change in credit risk cost
Coverage of liquidity outflows
Change in risk weighted assets
Additional assumptions
Contagion effects
Change in capital adequacy ratios and estimates of recapitalisation needs

Macroeconomic scenarios in solvency stress tests for FSR

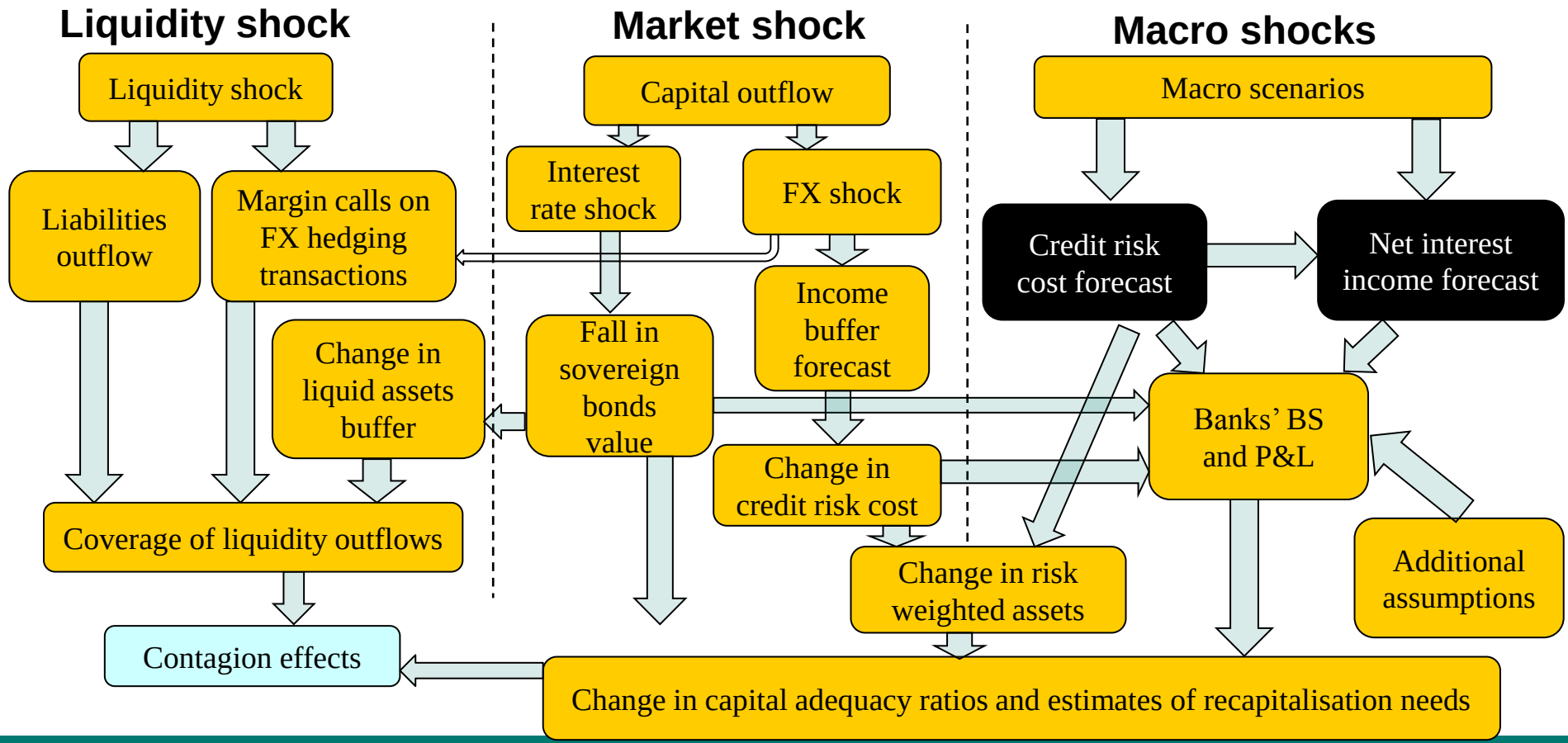
- Reference scenario – central path of the macroeconomic projection from the latest Inflation Report
  - fixed interest rates assumed - should not be treated as the expectation on the future!
- Shock scenario – projection from the multi-equation NECMOD model used for macroeconomic forecasts at the NBP
  - based on assumptions on external GDP growth and ''shock story''
  - developed by the experts from the Economic Institute



Reference and shock scenarios

Source: NBP, *Financial Stability Report. June 2017*

Satellite panel models of credit risk and interest margin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General specification

- Panel models of credit risk and interest margin as satellites for the macro model
  - variables projected by macro model enter panel models as explanatory variables
  - outputs of the panel models do not feed back to the macro model
- 3 equations for credit risk: housing, consumer and corporate loans
  - dependent variables: coverage of total (impaired and not impaired) loans by stock of impairment provisions
- 1 equation for net interest margin
  - dependent variables: ratio of annualised net interest income to average assets
  - interest income on debt securities excluded
- Dynamic panel model introduced by Arellano–Bover/Blundell–Bond
  - S-GMM estimated in Stata (xtabond2)

Data

- Quarterly data from Q1 1997 to the latest available
  - shorter sample for housing loans – better fit and more reliable forecast
  - data from end-1997 for NIM due to annualisation
- Macroeconomic and bank-specific explanatory variables
  - only lags to alleviate endogeneity problems
  - bank-specific variables (ratios) constant in projection period (unless forecast by other satellite models)
- Bank mergers accounted for by ”backward sum” approach
  - ”artificial” bank – sum of banks that were merged
- Some banks excluded from estimation:
  - history too short
  - insignificant share of a given loan portfolio

Credit risk models - variables

Variable	Abbreviation	Sign	Story	Construction
CHF exchange rate	CHF	+	Influence instalment of mortgages denominated in CHF	Level
GDP	pkb	-	Proxy for economic acivity	Change
Intrest rate	wibor	+	Most of loans in Poland are floating rates loans so it impacts level of instalment	Level
Unemployment rate	unemp	+	Work is the main source of income for creditors	Level
Employment	emp	-	Proxy for unemployment and companies condition	Change
Real wage fund	Wage_fund	-	Determines disponable income thus loan repaying capacity	Change

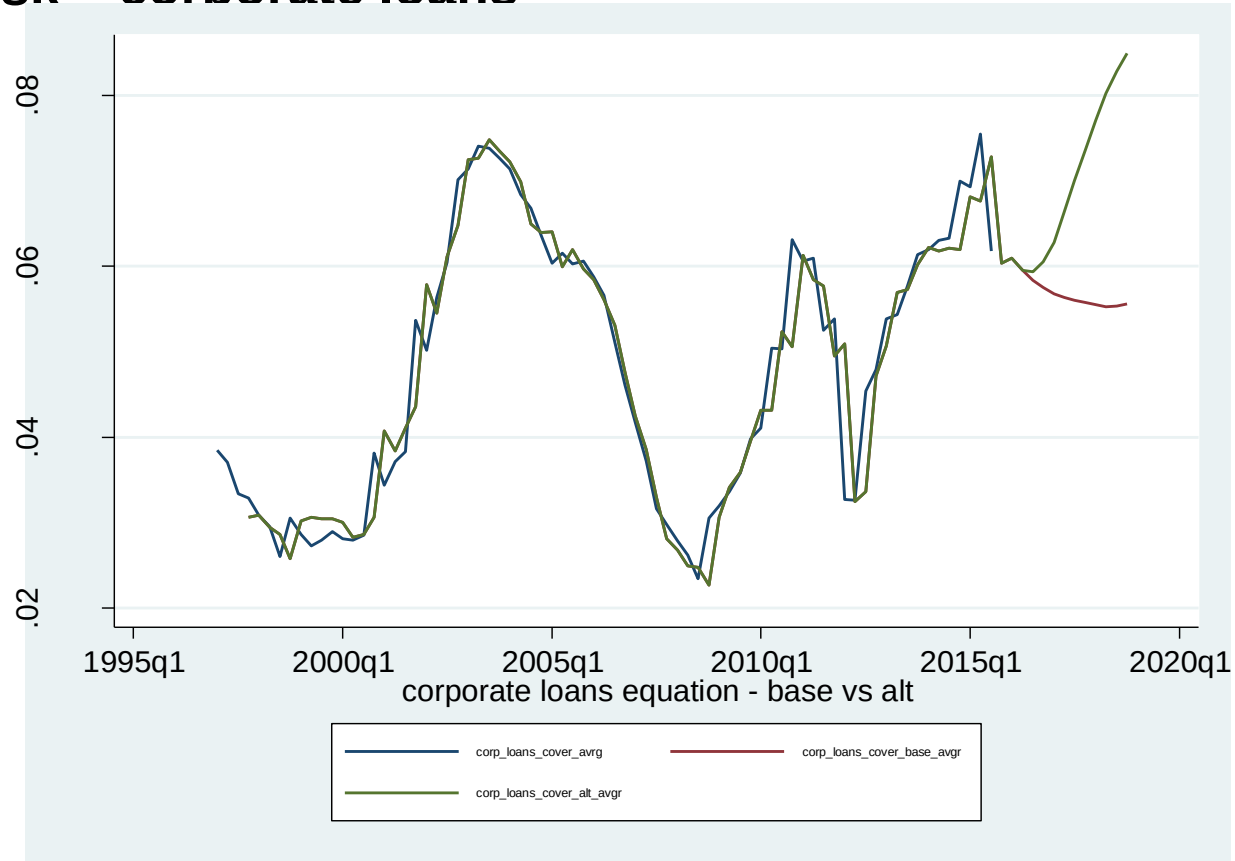
Credit risk – corporate loans

Explanatory variables:

- Lagged dependent variable
- Annual GDP growth
- Annual growth rate in corporate loans at bank level
- Annual change in employment rate
- Dummies:
  - IFRS introduction
  - change in provisioning regulation

corp_loans_cover	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
corp_loans_cover						
L1.	.9037672	.0080778	111.88	0.000	.887935	.9195993
gdp						
L2.	-.0991826	.016066	-6.17	0.000	-.1306714	-.0676938
pracujacy						
L3.	-.0427208	.0119185	-3.58	0.000	-.0660807	-.019361
dummy_new_psr	.000503	.0022449	0.22	0.823	-.0038969	.0049029
dummy_ifrs	.0022048	.0021866	1.01	0.313	-.002081	.0064905

Credit risk – corporate loans



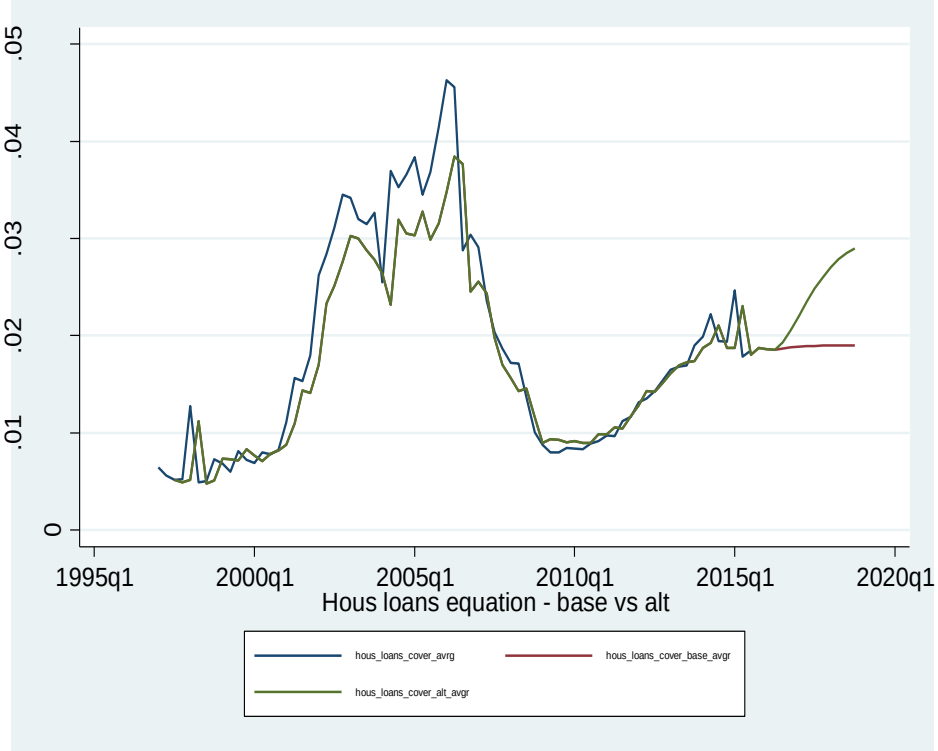
Credit risk – housing loans

Explanatory variables:

- Lagged dependent variable
- Annual GDP growth
- Annual change in unemployment rate
- Quarterly average CHF/PLN exchange rate
- Dummies:
  - IFRS introduction – out of sample
  - change in provisioning regulation – out of sample

hous_loans_cover	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
hous_loans_cover						
L1.	.7864084	.0098394	79.92	0.000	.7671236	.8056933
gdp						
L2.	-.014602	.0059503	-2.45	0.014	-.0262645	-.0029396
bezrobocie						
L2.	.006566	.0036075	1.82	0.069	-.0005047	.0136366
chf						
L2.	.0017151	.0002836	6.05	0.000	.0011593	.002271
dummy_new_psr	-.0024501	.0009295	-2.64	0.008	-.0042719	-.0006283
dummy_ifrs	-.0011464	.0008415	-1.36	0.173	-.0027957	.0005028

Credit risk – housing loans



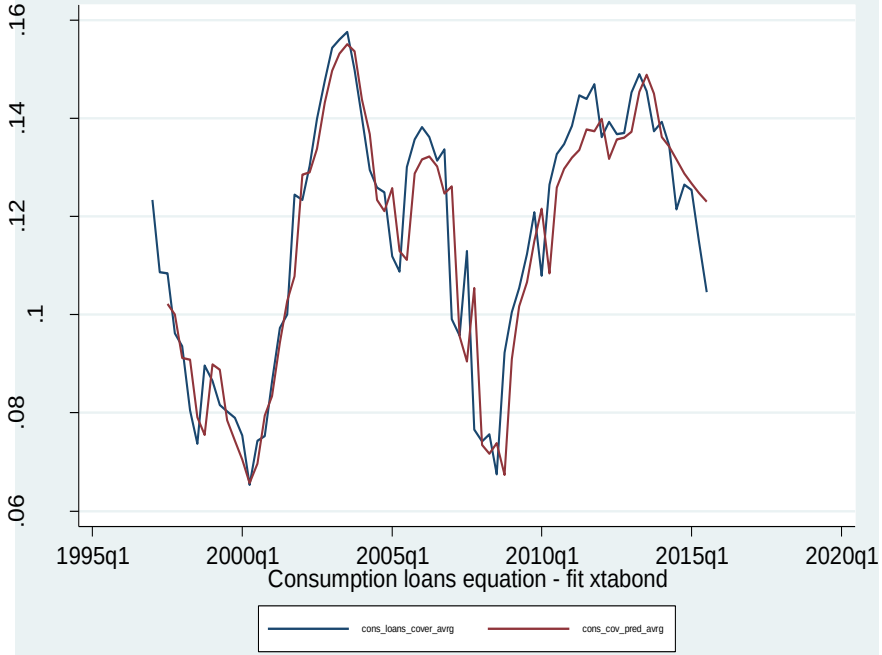
Credit risk – consumer loans

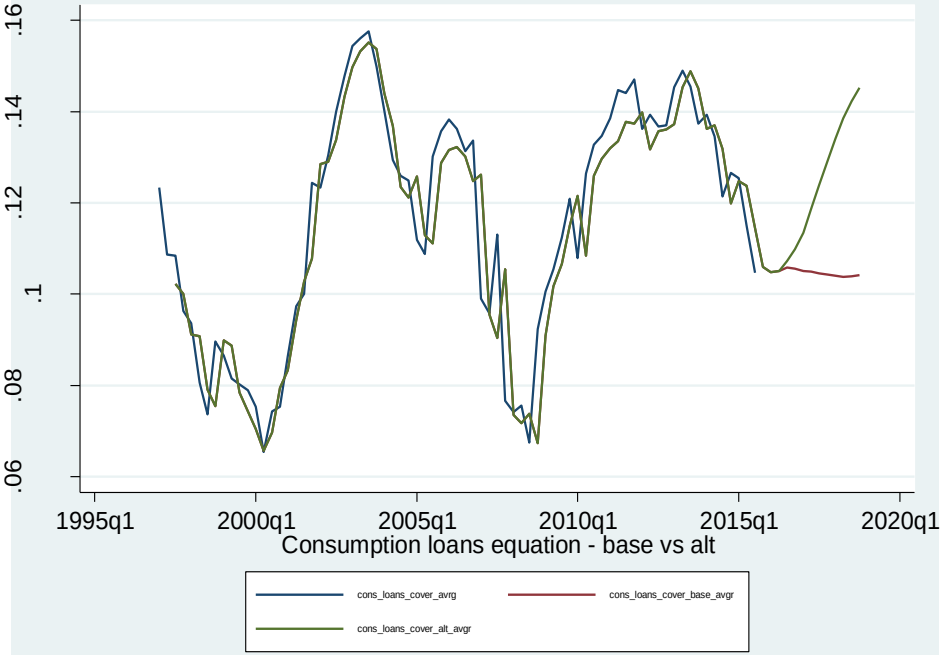
Explanatory variables:

- Lagged dependent variable
- Annual GDP growth
- Annual real wage fund growth
- 3m interbank rate (WIBOR)
- Provision ratio from credit risk model

cons_loans_cover	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
cons_loans_cover						
L1.	.8755657	.0106921	81.89	0.000	.8546096	.8965217
gdp						
L2.	-.1175898	.0327646	-3.59	0.000	-.1818071	-.0533724
fundusz_plac						
L2.	-.0390195	.0093225	-4.19	0.000	-.0572913	-.0207478
wibor						
L2.	.0242166	.0126671	1.91	0.056	-.0006104	.0490436
dummy_new_psr	-.0023564	.0046449	-0.51	0.612	-.0114603	.0067474
dummy_ifrs	.0028411	.0046402	0.61	0.540	-.0062535	.0119356

Credit risk – consumer loans





NM model - variables

Variable	Abbreviation	Sign	Story	Construction
GDP	GDP	+	Rise in economic activity leads to higher demand on credit that allows banks to use higher margins.	change
Short term interest rate	wibor	+	Banks tend to charge higher commissions and margins in the times of loose monetary policy.	level
Credit losses	prov_ratio	-	No interest are paid on non-performing loans.	level

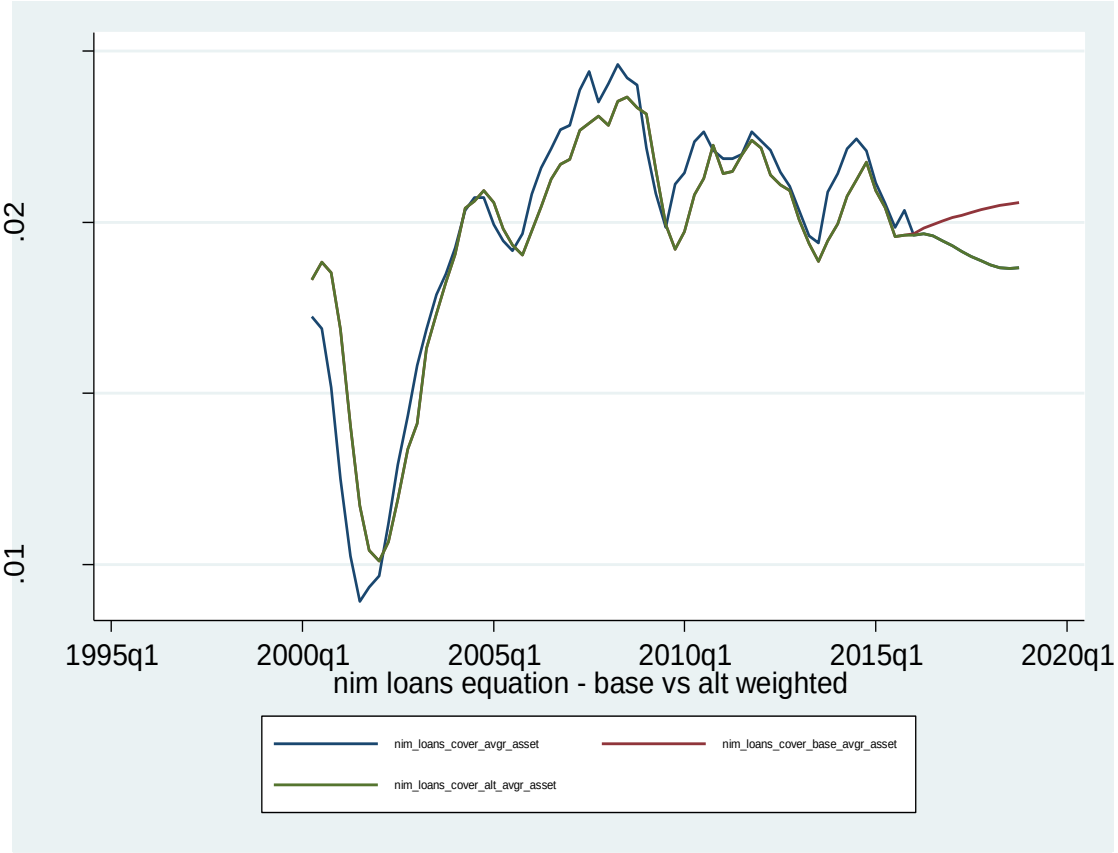
NIM – net interest margin

Explanatory variables:

- Lagged dependent variable
- Annual GDP growth
- 3m interbank rate (WIBOR)
- Provision ratio from credit risk model

nim	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
nim						
L1.	.9044025	.0057875	156.27	0.000	.8930592	.9157458
gdp	.0078667	.0055527	1.42	0.157	-.0030164	.0187497
wibor	.0117551	.0028507	4.12	0.000	.0061678	.0173425
prov_ratio_nf_mgrs	-.0039382	.0033476	-1.18	0.239	-.0104994	.0026231

NIM – net interest margin



We protect the value of money