# The Quarterly Projection Model

## A brief description and overview

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South African Reserve Bank

# The QPM : a description & overview

- Evolution of models at the SARB
- Key concepts of the QPM
  - Reasons for the change from the “core model”
- Steady states of the QPM
- Key structural equations
- Monetary policy in the QPM
- Shocks & decompositions

# Evolution of Models SARB

- Early 1990-2000's models :
  - Mostly long run relationships (highly disaggregated)
  - 350 equations & identities
  - Difficult to assess monetary policy transmission mechanism (MPTM)

- IT model (Feb 2000) :
  - Much smaller aggregated model 25 equations
  - Well defined channels of the MPTM (interest rates, growth & inflation)
  - Assistance from other central banks (BoE, BoC, etc)
  - Long run homogeneity imposed

- General equilibrium models (2007)
  - Only officially used towards end of 2017

# Key concepts : QPM

- Steady states
  - Where we ultimately want to be *"utopia"*
  - Model consistent steady states

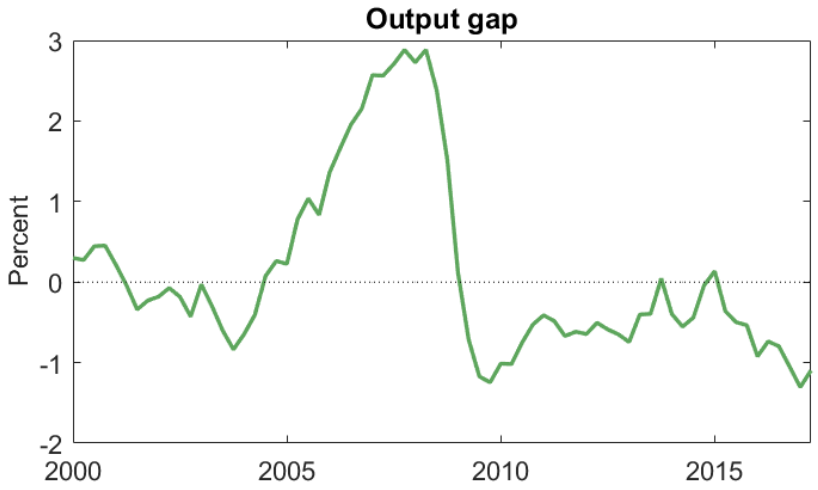
- Equilibrium levels
  - Trend variables (inputs from supplementary models)
  - Converge towards steady state

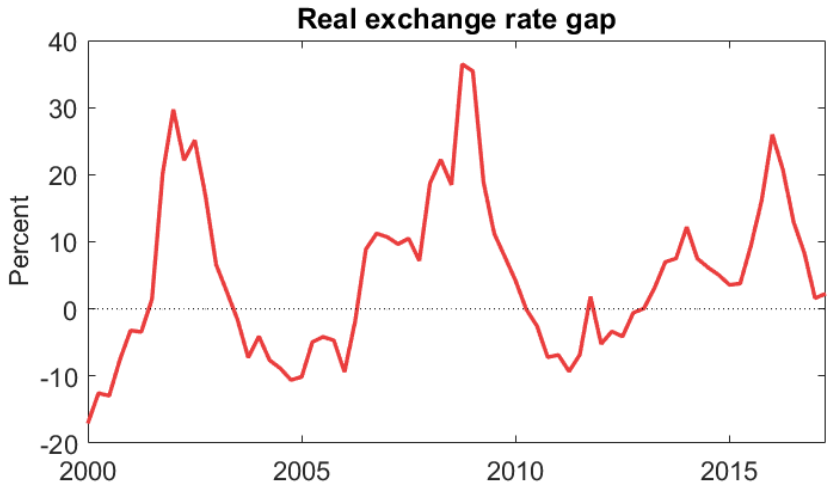
- Gaps
  - Output, exchange rate, interest rate & inflation
  - Expressed as deviations from equilibrium
  - Initial conditions (starting points) are crucial to evolution of gaps

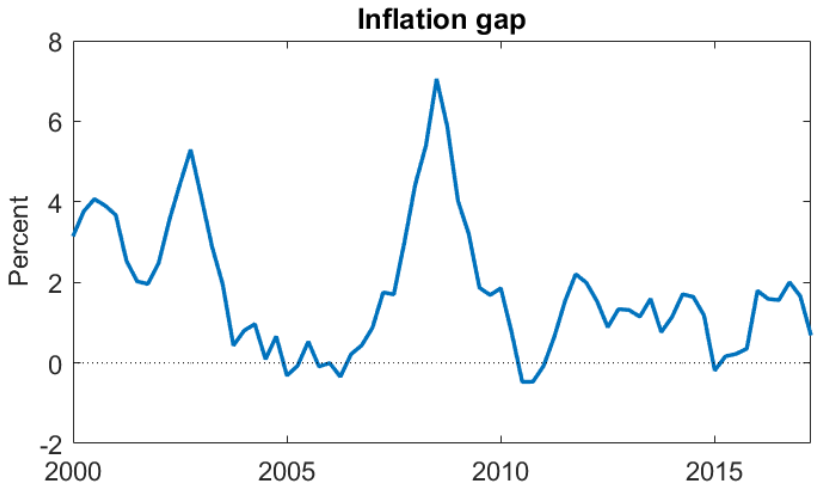
➢ *Steady state is achieved when all gaps are closed and the equilibrium levels have converged towards their steady states… this may take some time…*

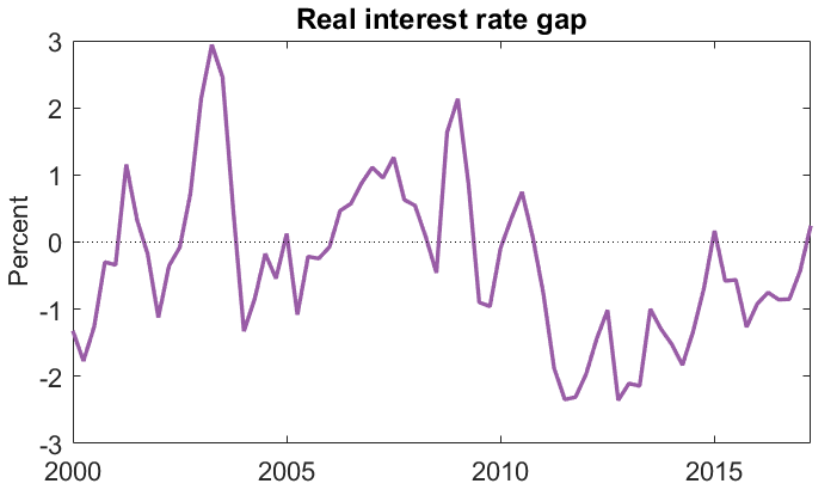
# Gaps, equilibriums and steady states

# The four main gaps

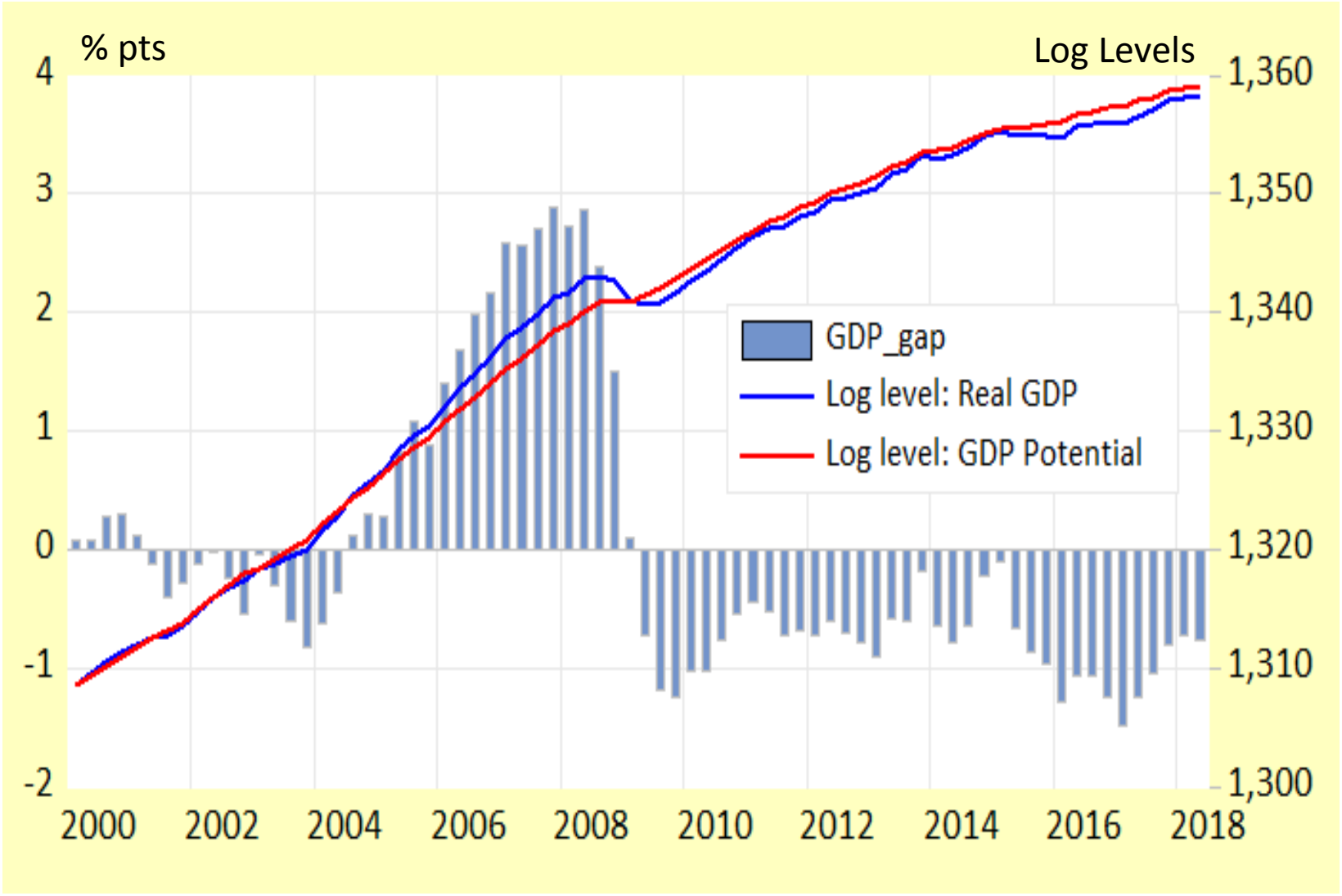


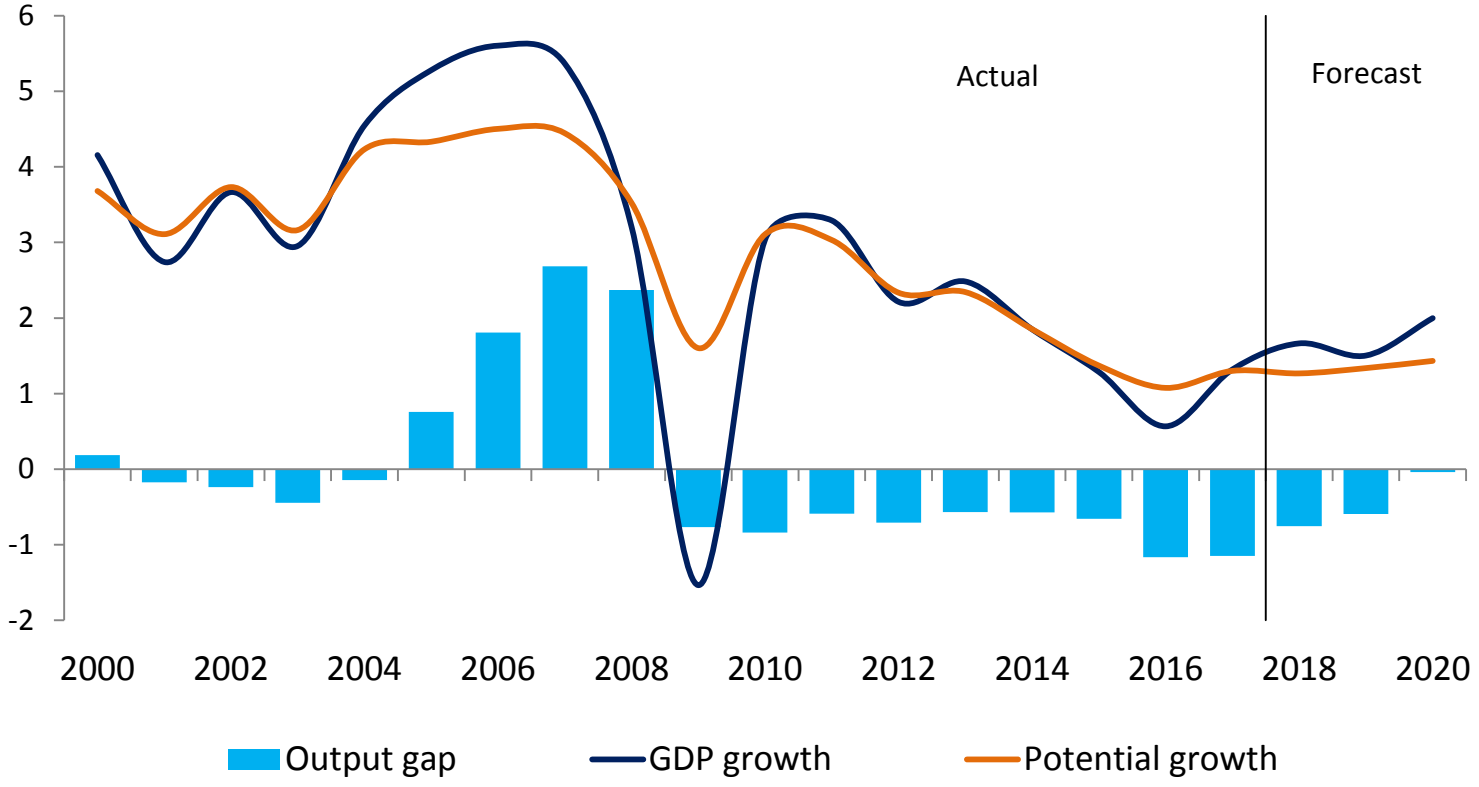



# Closing the gaps : Real GDP



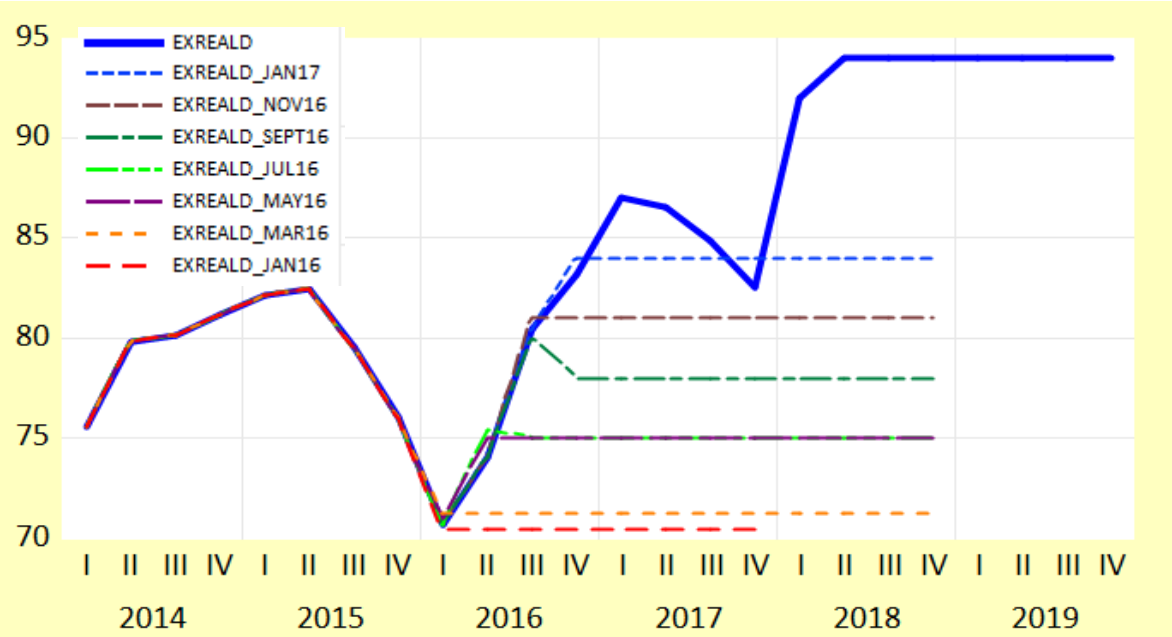
# Closing the gaps : Real GDP

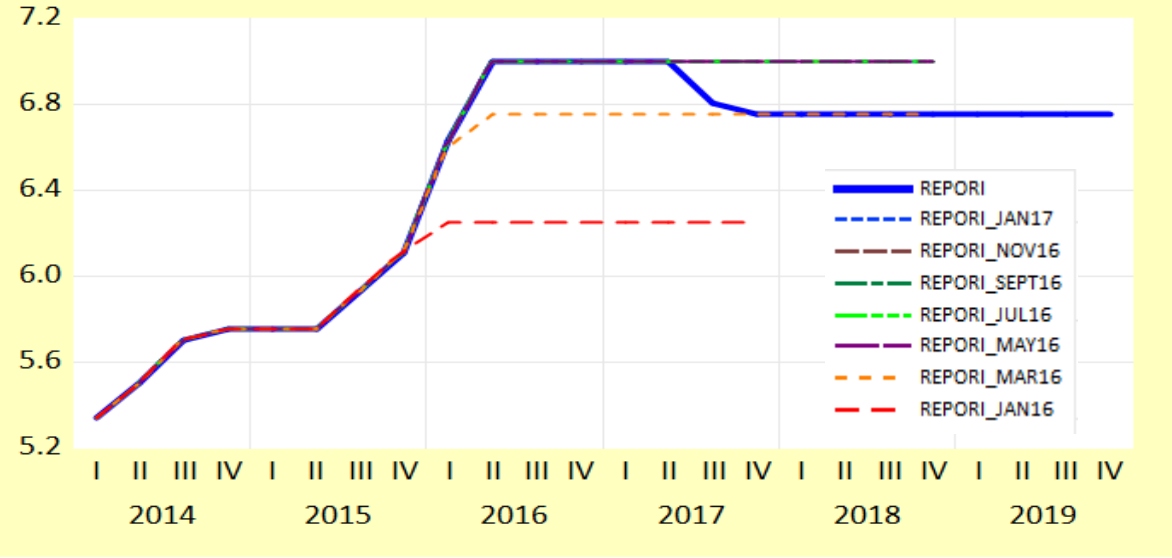
**% yoy Real GDP's with the gap as %pt difference**



# Why the change : The Core model ?

- Constant assumptions :
  - Real exchange rate
  - Interest rates

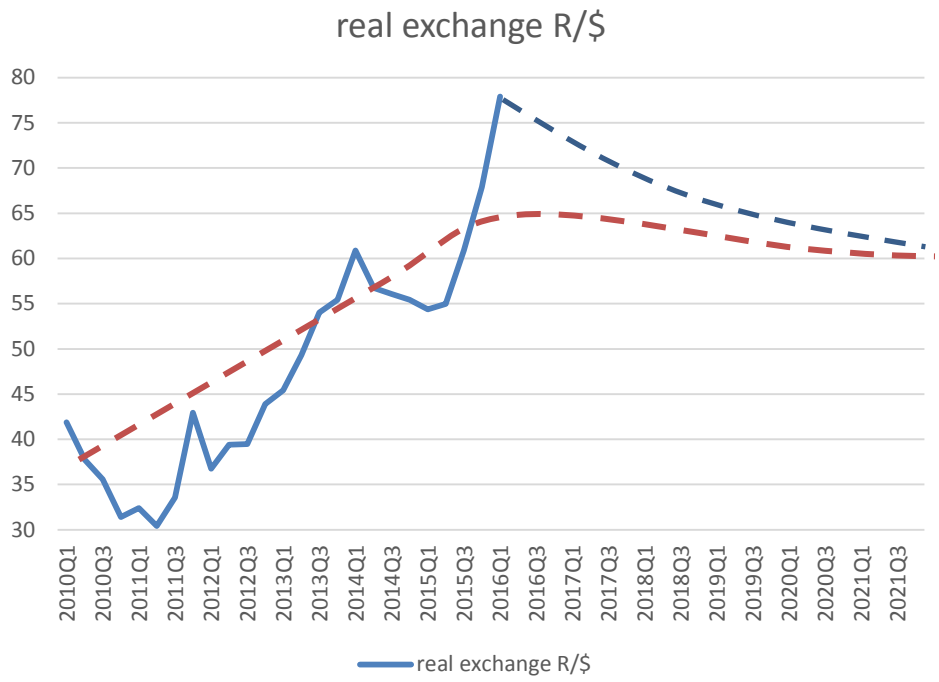


# Why the change : The QPM

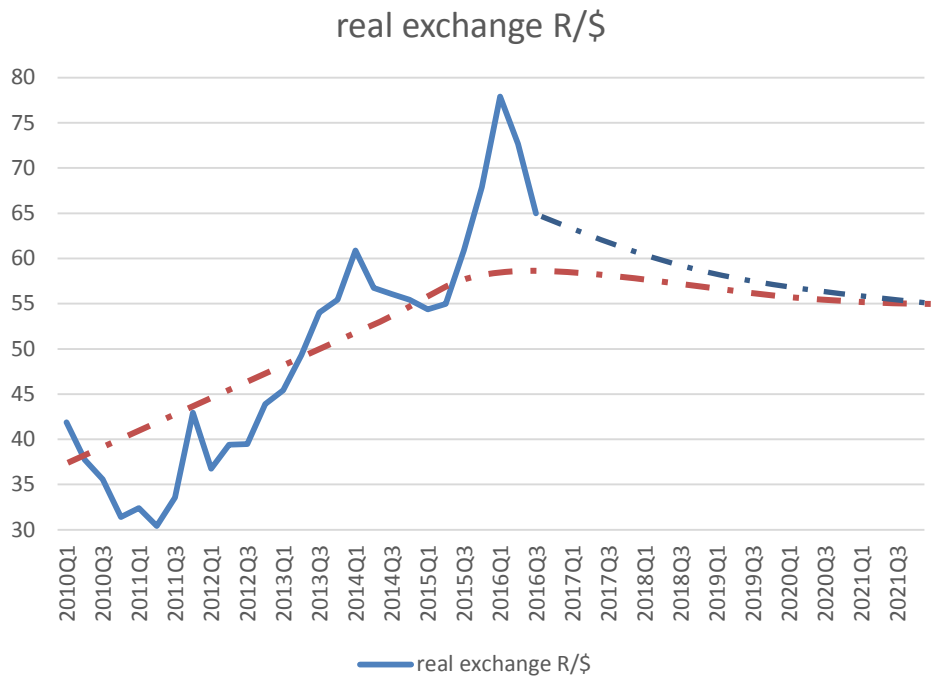
- Forward looking
- International best practice
- Produces model consistent repo and exchange rate forecasts
- Enhances communication
  - Repo path required to guide inflation back to target

# The QPM 2016q1




- Real R/$ that is above the equilibrium signifies undervaluation of the currency
  - Serves to reduce/narrow the negative output gap, but adds to inflation pressures

# The QPM : 2016q3

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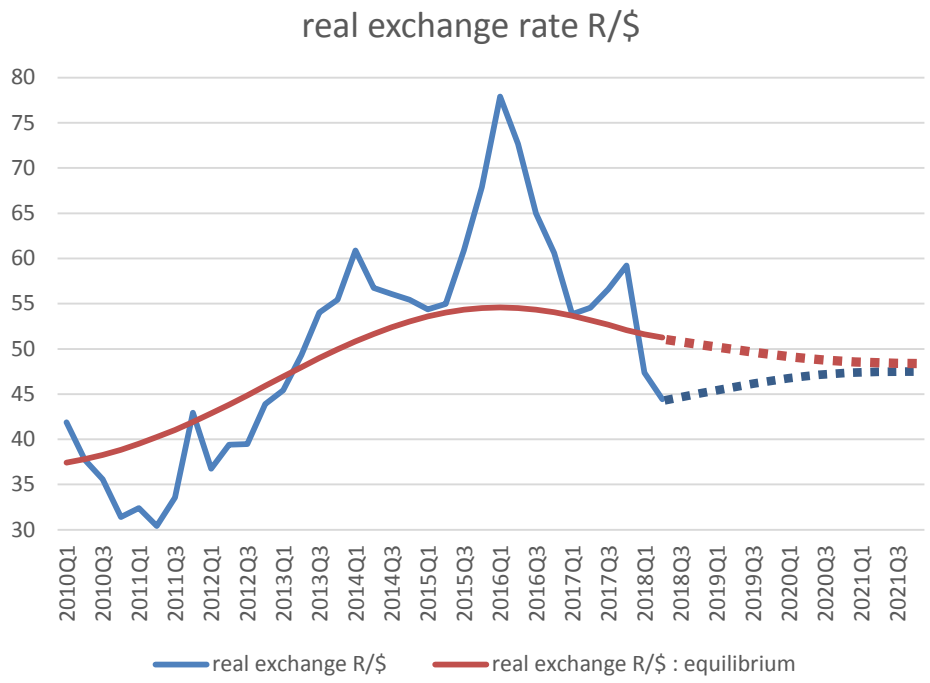
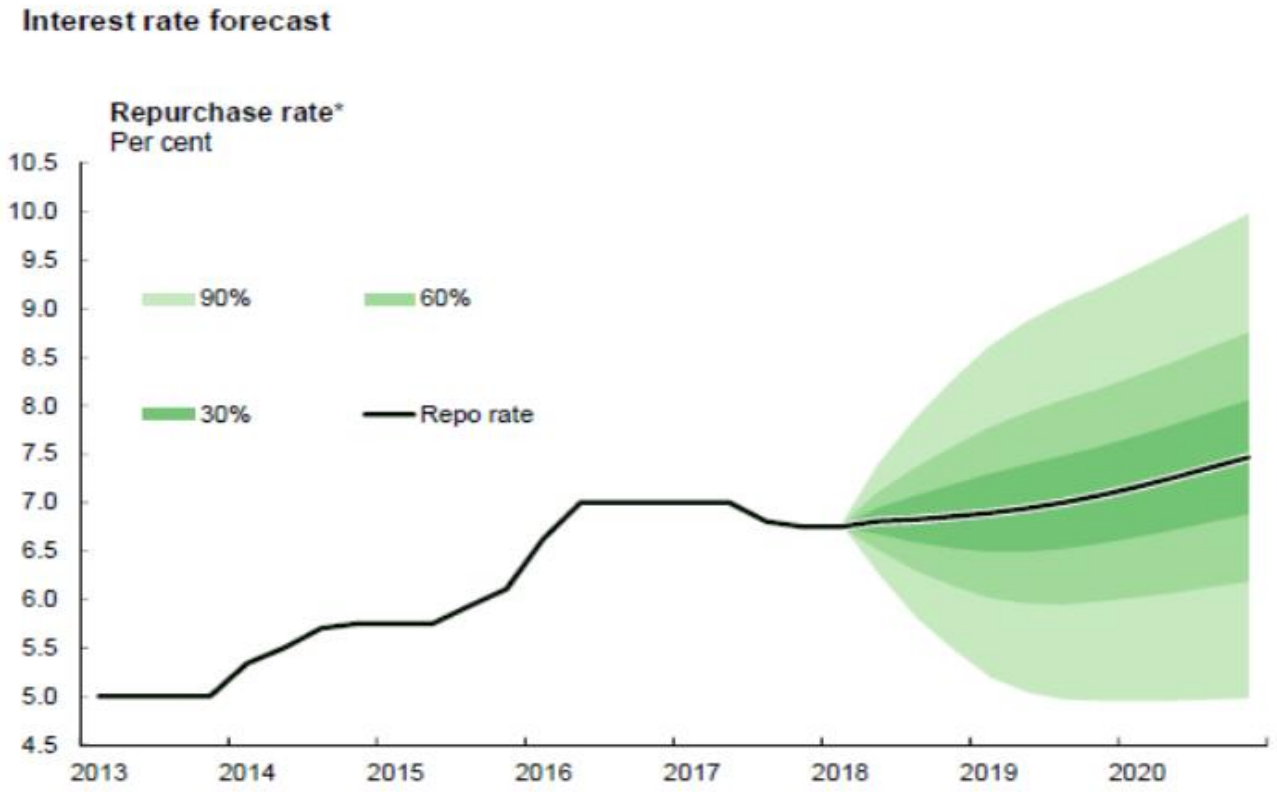
# The QPM : 2018q1




- Real R/$ that is below the equilibrium signifies overvaluation of the currency
  - Serves to add to/widen the negative output gap, but draws down on inflation pressures

# The new addition to our communication efforts : March 2018 MPC




*The uncertainty bands for the repo rate are based on historical forecasting experience and stochastic simulations in the Quarterly Projection Model (QPM). The bands are symmetric, and therefore do not reflect any assessment of upside or downside risk. For details on the QPM see 'The quarterly projection model of the SARB', South African Reserve Bank Working Paper Series No. WP/17/01, September 2017.

# The model's steady states

# QPM steady states

**Steady states (per cent)**

| **Policy variables** | **Domestic** | **Foreign** |
|---|---|---|
| Inflation target | **4.5** | 2 |
| Neutral real interest rate | 2.5 | 0.5 |
| Neutral nominal interest rate | 7 | 2.5 |
| **Exchange rates** | | |
| Real exchange rate depreciation | 0 | |
| Nominal exchange rate depreciation | 2.5 | |
| Risk premium | 2 | |

| **Formula** | | | |
|---|---|---|---|
| UIP: | rr | = | rr* + Δ(real exch) + prem |
| Fisher equation: | r | = | rr + inflation |
| PPP: | Δ(nominal exch) | = | Δ(real exch) + (infl - infl*) |

SS value policymaker chooses

SS value policymaker has no control over

SS value derived to ensure long-run consistency

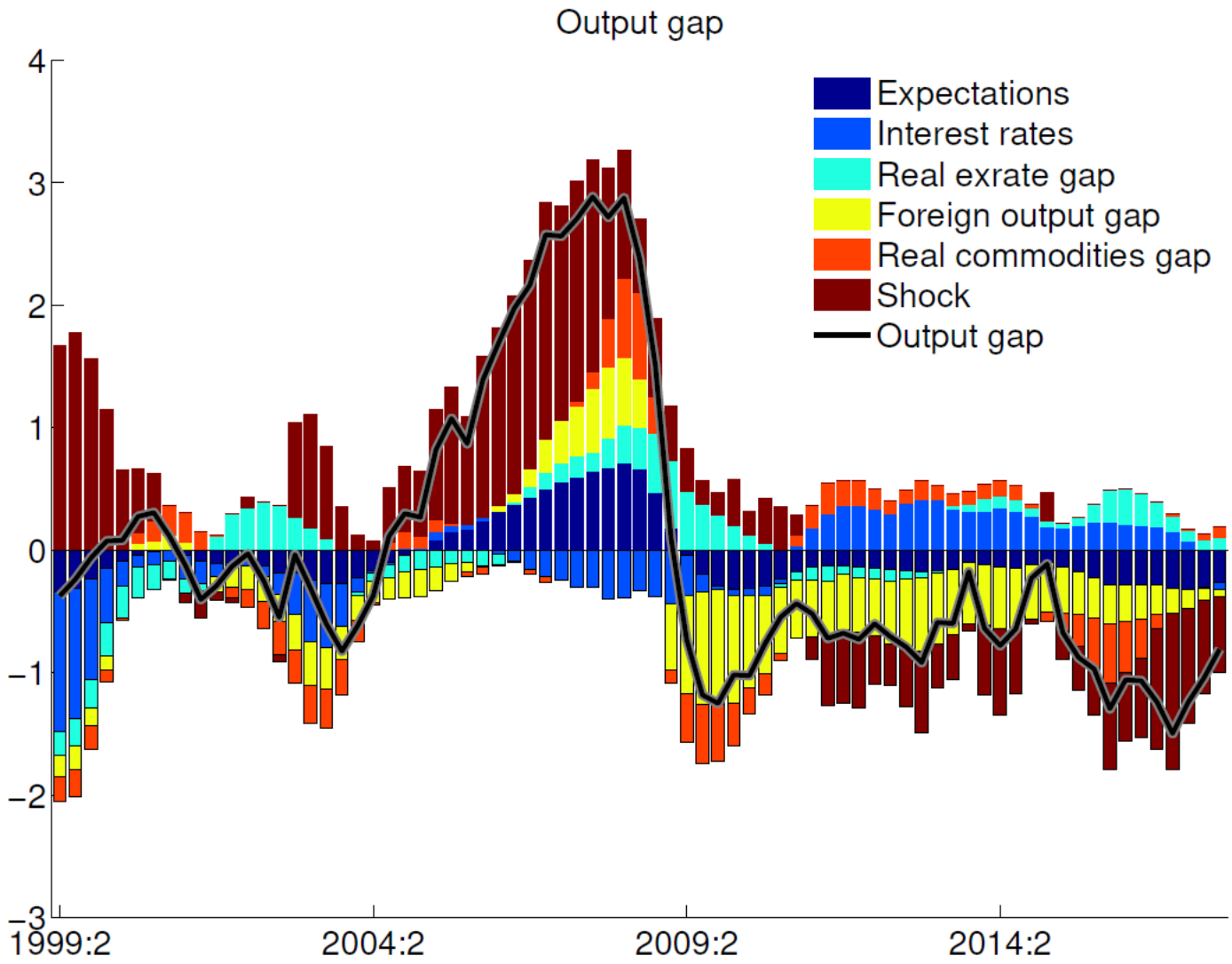
# Key equations

## The real economy

- Equation for:
  - Aggregate demand (IS curve)

Output gap = b1 * expected output gap
+ b2 * lagged output gap
- b3 * real interest rate gap
+ b4 * real exchange rate gap
+ b5 * world output gap
+ b6 * real commodity price gap
+ residual

# Decomposition of the output gap



# The price block

# Inflation will be what long-run inflation expectations are

= 4.5

CPI = b1*expectations of CPI = 4.5

+ b2*lagged CPI = 4.5

+ b3*imported inflation = 4.5

~~+ b4*real marginal cost~~ = 0 (gaps close)

~~+ shocks~~ = 0

* Coefficients b1 + b2 + b3 = 1 for stability

[1] Imported inflation is equal to the foreign inflation target (2%) plus the nominal exchange rate depreciation from purchasing power parity (6-2 = 4%)

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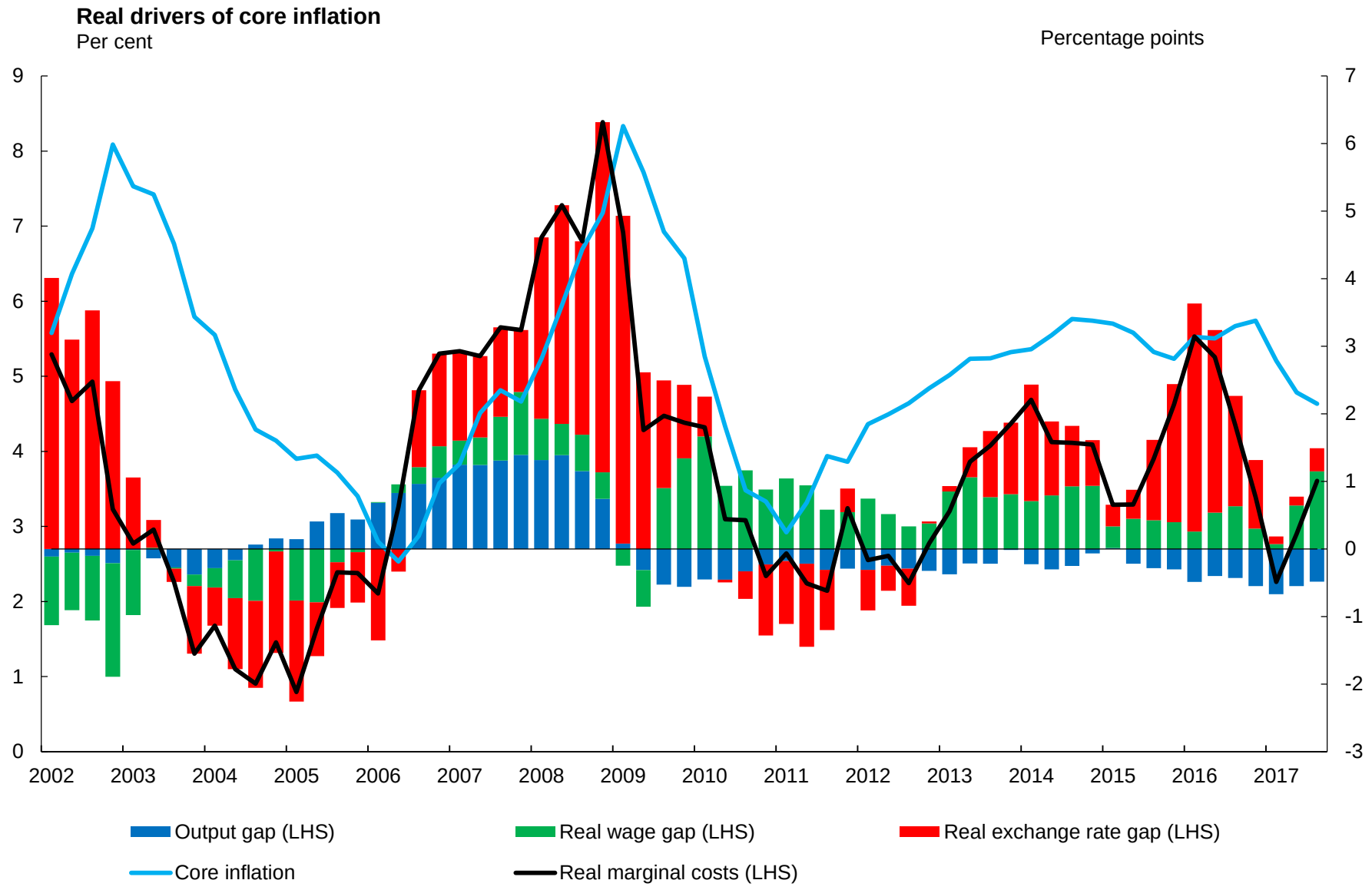
# The producer's cost of inputs: real marginal cost



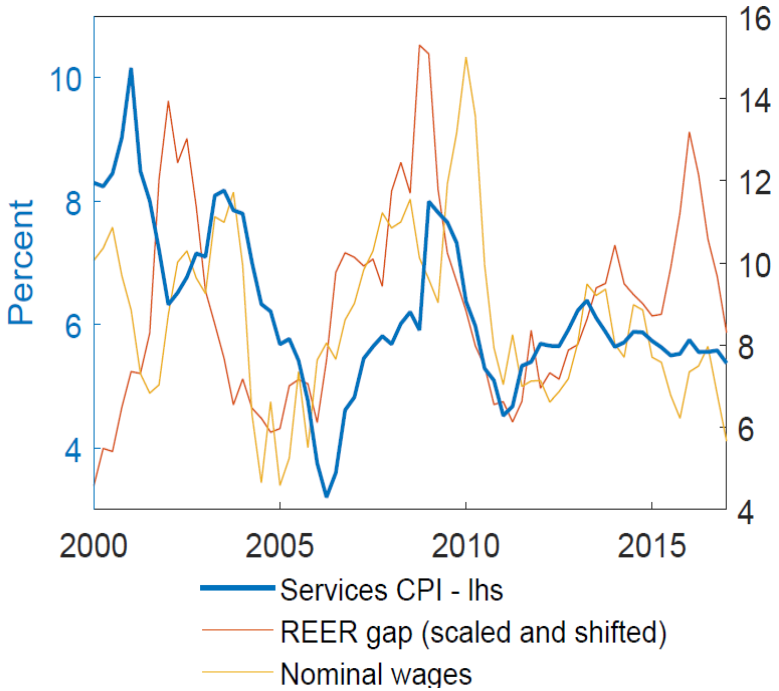
# The price block breakdown

Equations:

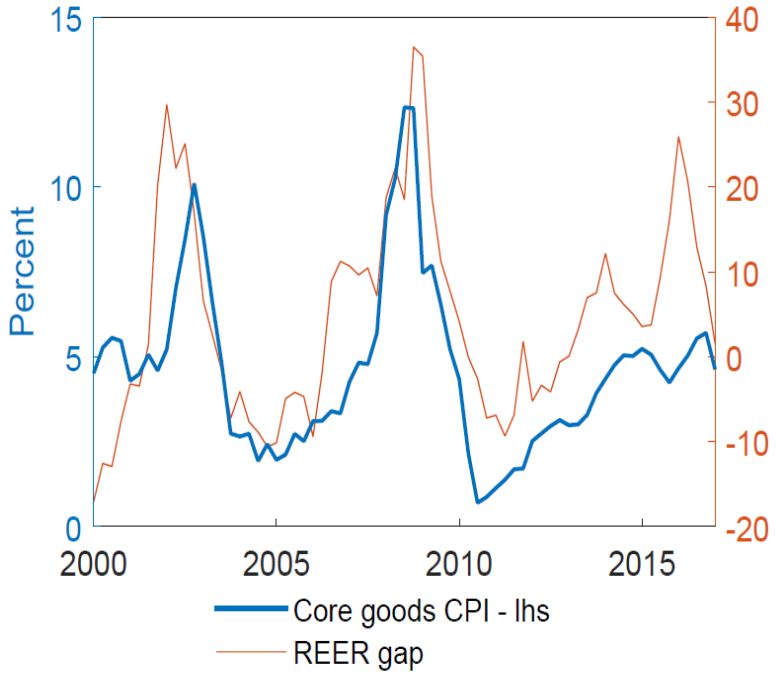
- Core CPI
  - Services CPI
  - Core goods CPI
- Food CPI
- Petrol CPI
  - Determined by nominal exchange rate, plus assumptions for Brent crude (USD) and taxes/margins
- Electricity CPI
  - Determined by assumption
- Headline CPI is weighted sum of the above

# The price block: Services and core goods

**Services CPI, %yy**




**Core goods CPI, %yy**



# The price block: Wage inflation

Nominal wage inflation = b1* expectations of future wages
+ b2 * lagged wages
+ b3 * lagged headline CPI
+ b4 * output gap
- b5 * real wage gap
+ residual

# Exchange rate: modified UIP

- Nominal exchange rate = b1*Expectations of exchange rate
  + (1 - b1)*lagged exchange rate
  - repo rate
  + world interest rate
  + risk premium
  + residual

- Real exchange rate = nominal exchange rate*(world CPI/SA CPI)

# Monetary policy

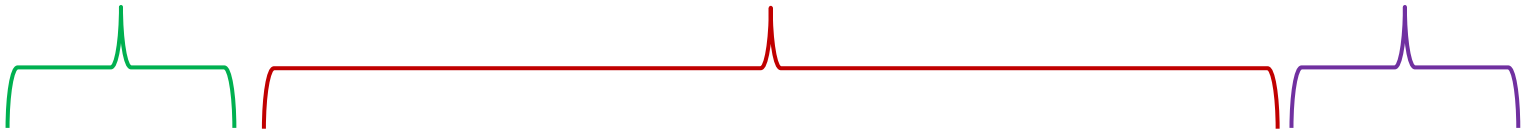
# The policy rule: three things matter

1) Neutral nominal interest rate

2) Inflation from target

3) Output gap

$$i_t^{neutral} = \bar{r}_t + \pi_t^{target},$$

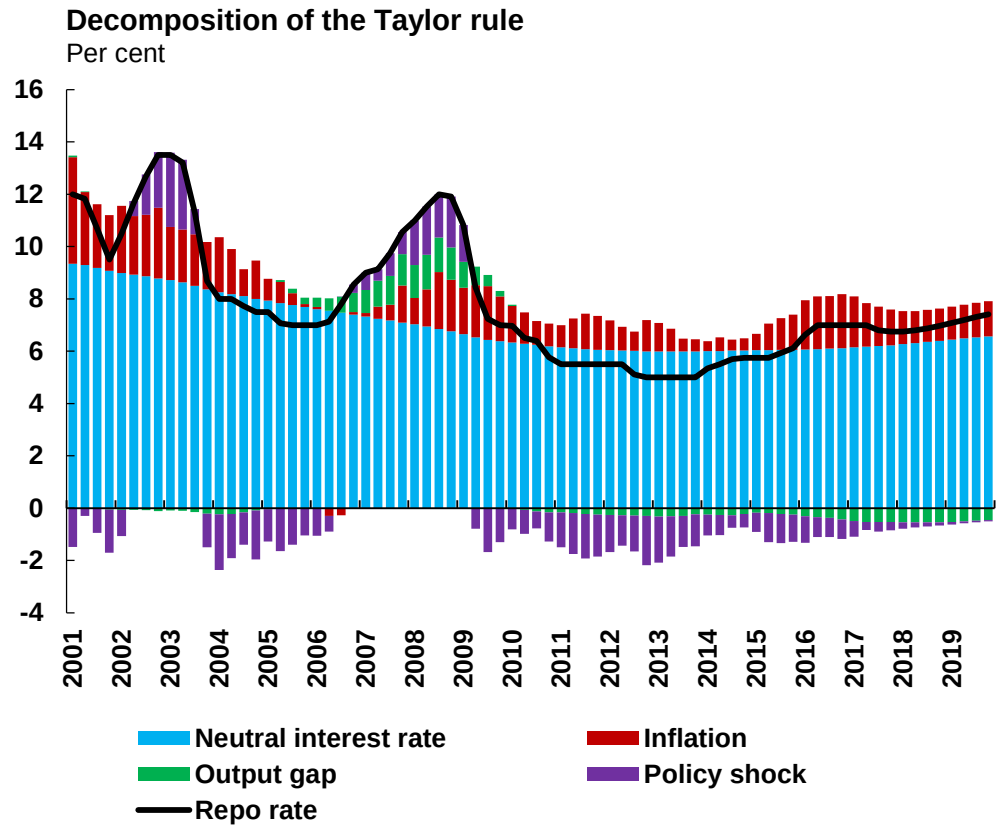


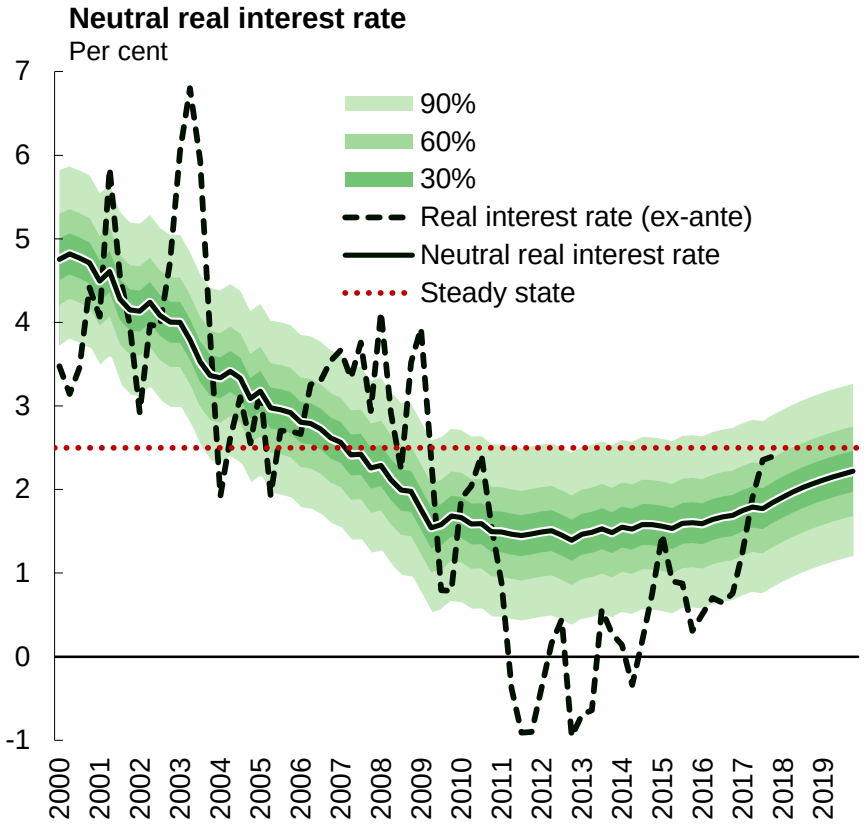
$$\begin{aligned} i_t &= f_1 i_{t-1} \\ &+ (1-f_1)\left\{ i_t^{neutral} + f_2\left[\frac{1}{3}\cdot\left(E\pi_{t+3}^{4,cpi} + E\pi_{t+4}^{4,cpi} + E\pi_{t+5}^{4,cpi}\right) - E\pi_{t+4}^{target}\right] + f_3\widehat{y}_t \right\} \\ &+ \varepsilon_t^i \end{aligned}$$

$$f_1 = 0.79, \quad f_2 = 1.57, \quad f_3 = 0.54$$

# The neutral rate is consistent with long-run UIP

$$\text{Neutral} = \textit{Foreign neutral} + \textit{risk premium} + \textit{trend depreciation}$$



# How does monetary policy work in the QPM?

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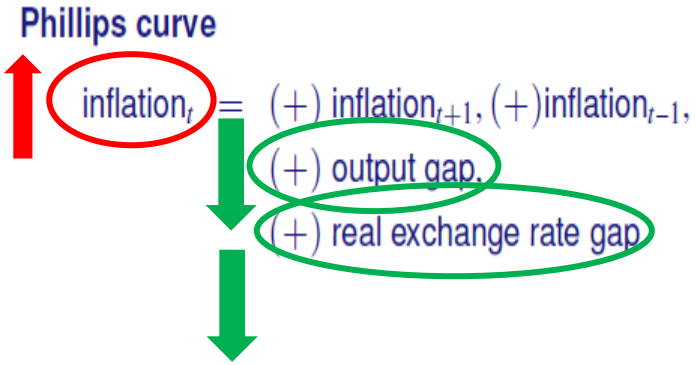


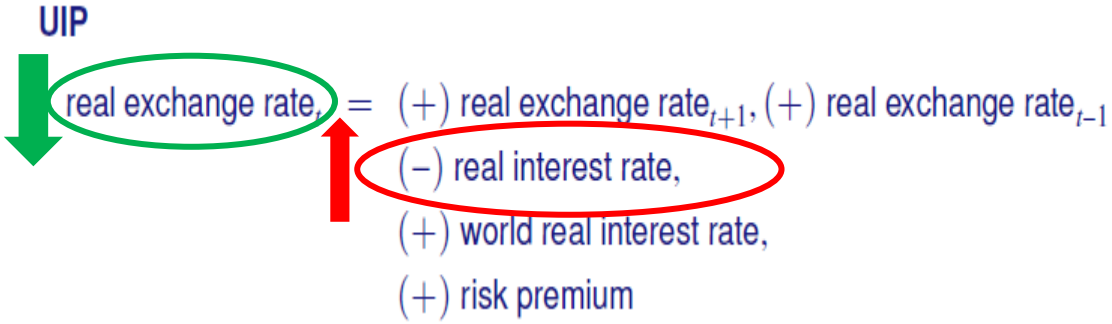


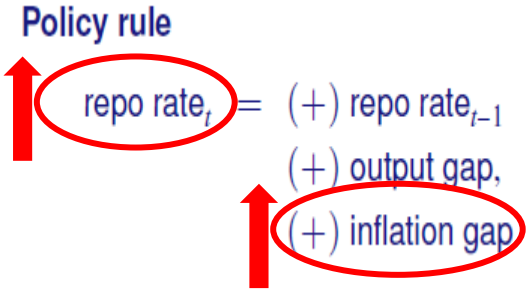

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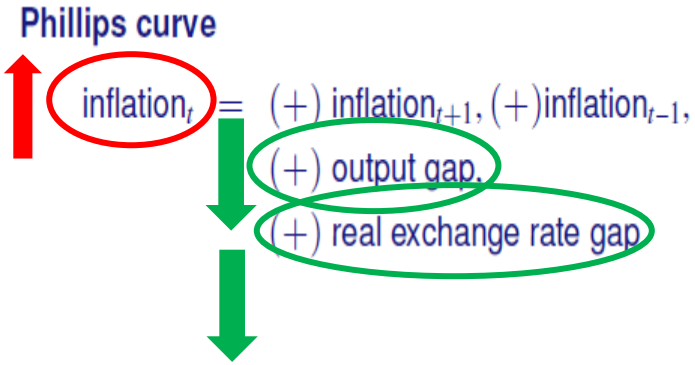
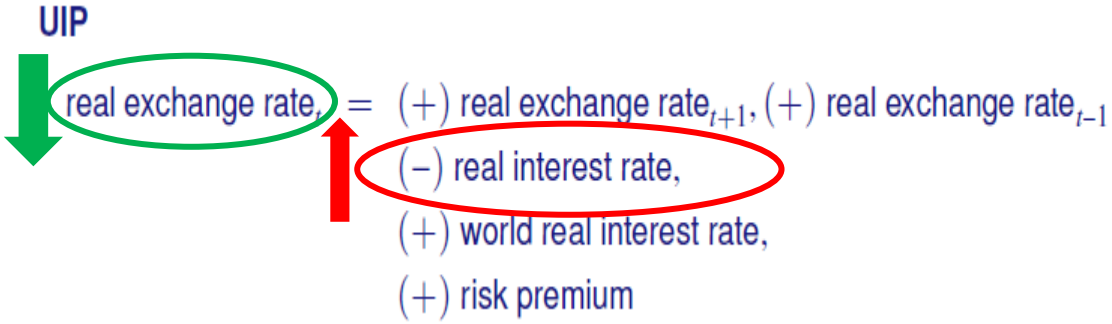
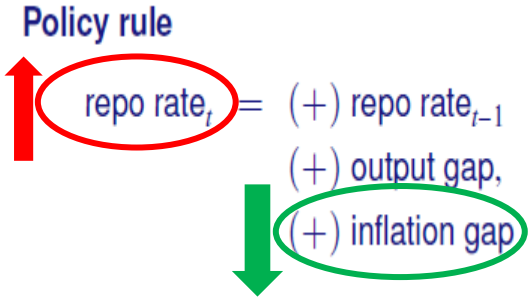


# How does monetary policy work in the QPM?

**Aggregate demand**

$$\text{output gap}_t = (+)\ \text{output gap}_{t+1},\ (+)\ \text{output gap}_{t-1},\ (-)\ \text{real interest rate gap},\ (+)\ \text{real exchange rate gap},\ (+)\ \text{world output gap}$$

**Phillips curve**

$$\text{inflation}_t = (+)\ \text{inflation}_{t+1},\ (+)\text{inflation}_{t-1},\ (+)\ \text{output gap},\ (+)\ \text{real exchange rate gap}$$

**UIP**

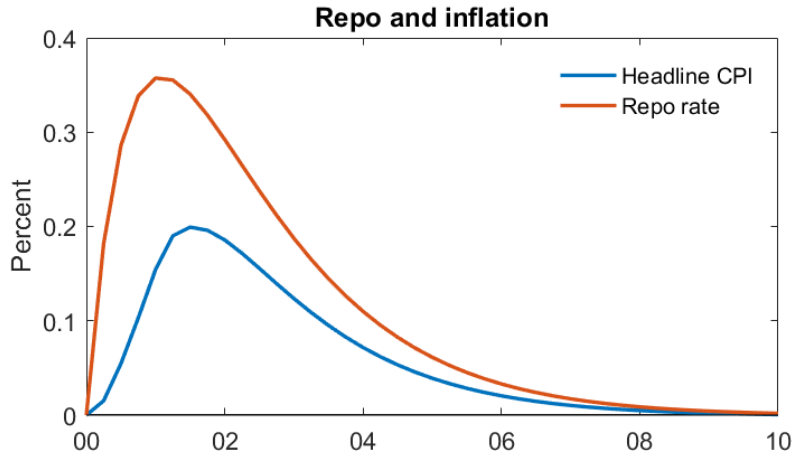
$$\text{real exchange rate}_t = (+)\ \text{real exchange rate}_{t+1},\ (+)\ \text{real exchange rate}_{t-1},\ (-)\ \text{real interest rate},\ (+)\ \text{world real interest rate},\ (+)\ \text{risk premium}$$

**Policy rule**

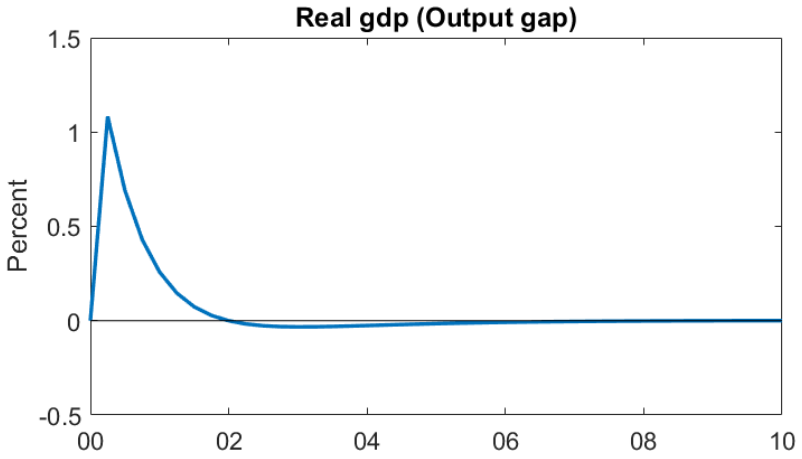
$$\text{repo rate}_t = (+)\ \text{repo rate}_{t-1},\ (+)\ \text{output gap},\ (+)\ \text{inflation gap}$$

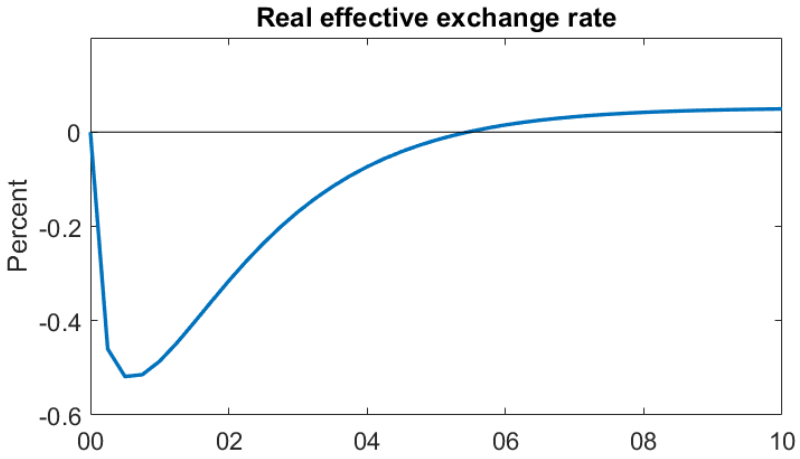
# Impulse responses: model response to shocks

# 1% GDP shock


Repo and inflation
Headline CPI
Repo rate
Percent
0.4
0.3
0.2
0.1
0
00
02
04
06
08
10


Wage inflation
Percent
0.2
0.15
0.1
0.05
0
00
02
04
06
08
10


Real gdp (Output gap)
Percent
1.5
1
0.5
0
-0.5
00
02
04
06
08
10


Real effective exchange rate
Percent
0
-0.2
-0.4
-0.6
00
02
04
06
08
10

# Thank you