Evaluating the macroeconomic effects of the ECB’s unconventional monetary policies

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Policy challenge I

- Following the Great Recession, central banks lowered their rates to their effective lower bound (ELB).
- To provide additional stimulus, they introduced a number of unconventional policies (i.e., forward guidance, asset purchase programmes, liquidity injections, etc).
- How can we measure the macroeconomic effects of these policies?
Despite the growing interest in UMPs, the literature mainly focuses on their effects on financial markets (survey by Bhattarai and Neely, 2016).

Fewer studies focus on the macroeconomic effects.

Notable examples include:
- Engen, Laubach and Reifschneider (2015): evaluate the effects of FG and QE in the US by including private sector forecasters’ perceptions of monetary policy in a DSGE model.
- Wu and Xia (2016): assess the effect of the bulk of UMPs put in place in the US, by introducing a shadow rate in a factor-augmented VAR.
Our approach

- We use a DSGE model to gauge the macroeconomic effects of the ECB’s unconventional monetary policies (UMP).
- Within this framework we use a set of shadow rates to assess the overall stance of monetary policy.
  (i.e., summary measure of the total accommodation provided by conventional and unconventional policies)
Theoretically, nominal interest rates should not fall below the ZLB due to the option of holding cash.

Black (1995) provides a way to compute the value of an option to hold cash at the ZLB.

However, episodes of negative policy rates have occurred in the euro area since June 2014 (convenience yield).
Shadow rates are obtained via term structure models which account for the ELB (Kim and Singleton, 2012; Krippner, 2012; Christensen and Rudebusch, 2015, 2016) → short rate that would generate the observed yield curve had the ELB not been binding.

Shadow rates coincide with the policy rate in normal times and are unconstrained when the policy rate is stuck at the lower bound → no discontinuity.

The dynamic relationships between macroeconomic variables and monetary policy are preserved in any economic environment.
The shadow rate incorporates the effect of monetary policy measures on: (i) current economic conditions and (ii) market expectations about future policy actions.

Exploiting the entire yield curve allows accounting for the influence of direct and/or indirect market interventions on medium- long-term maturity rates.

Importantly, using a NK model, Wu and Zhang (2017) show that the impact of unconventional policies (QE and lending facilities) on the economy is identical to that of negative shadow rates.

Convenient indicator for measuring the total accommodation provided by conventional and unconventional policies (Krippner, 2013; Wu and Xia, 2016).
Quantifying the macroeconomic effects of UMPs

We opt for a macroeconomic model that is structural in the sense that:

- It formalises the behaviour of economic agents on the basis of explicit micro-foundations;

- It appropriately controls for the effects of policy measures through expectations — Lucas (1976) critique.
DSGE model description I

- General equilibrium model à la Smets and Wouters (2007).

- Medium-scale model which has been successful in providing an empirically plausible account of key macroeconomic variables.

- Includes several shocks and real and nominal frictions.

- It features habit formation, investment adjustment cost, variable capital utilisation, monopolistic competition in goods and labor markets, and nominal price and wage rigidities.
DSGE model description II

We deliberately choose this standard framework:

- It is challenging to incorporate all the channels through which we think UMPs can act (let alone the breadth of UMPs implemented by the ECB).

- Introducing a shadow rate in a model has the advantage of by-passing the non-linearity stemming from the existence of the lower bound.
Uncertainty surrounding shadow rate measurement I

-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5

Kortela Lemke-Vladu Wu-Xia

FRFA repos 1Y-LTRO, CBPP SMP 3Y-LTRO Forward guidance "Whatever it takes" + OMT TLTRO EAPP extension I TLTRO II EAPP extension II

Reactivation of SMP
Uncertainty surrounding shadow rate measurement II

- We introduce in the Taylor rule the common component extracted from a set of shadow rates:

\[
\frac{S_t}{S} = \left( \frac{S_{t-1}}{S} \right)^{\varphi_s} \left[ \left( \frac{\pi_t}{\pi} \right)^{\varphi_{\pi}} \left( \frac{Y_t}{\gamma_z Y_{t-1}} \right)^{\varphi_y} \right]^{(1-\varphi_s)} \varepsilon_{s,t},
\]

where \( \varepsilon_{s,t} \) is a monetary policy shock.

- In order to reduce a set of three shadow rate measures \( S_{1,t}, S_{2,t}, S_{3,t} \) to a single variable \( S_t \) we use a common factor structure and embed it directly in the model:

\[
\begin{align*}
\frac{S_{1,t}}{S_1} &= \frac{S_t}{S} \varepsilon_{s1,t} \\
\frac{S_{2,t}}{S_2} &= \frac{S_t}{S} \varepsilon_{s2,t} \\
\frac{S_{3,t}}{S_3} &= \frac{S_t}{S} \varepsilon_{s3,t},
\end{align*}
\]

where \( \varepsilon_{s1,t}, \varepsilon_{s2,t}, \varepsilon_{s3,t} \) are shocks capturing the idiosyncratic variance of each measure.
To assess the effects of unconventional policies, we build counter-factual scenarios which inform us about the state of the economy in the absence of such policies.

- **Observed**
  - State of the world with *conventional & unconventional* policies
  - Shadow rate

- **Counter-factual**
  - State of the world with only *conventional* policies
  - Policy rate

From the comparison we deduce the **Pure effect of unconventional** policies.
Counter-factual analysis II

In order to assess the state of the economy in the absence of the ECB’s policies, we must build counterfactual scenarios.

We proceed as follows:

1. We take the mean of the posterior estimates of the structural parameters and compute the associated estimates of monetary policy shocks using the Kalman filter $\rightarrow$ shocks from all monetary policy decisions ("observed").
2. We replace the observed monetary policy shocks with shocks that keep the shadow rate at the level of the Eonia rate –all other parameters held fixed as in step 1 ("counterfactual").
3. We compute the simulated time-paths for the observed variables from the baseline model (with shadow rate) using the first and second sets of monetary policy shocks.
Empirical study: euro area

- Wide array of unconventional monetary policies adopted by the ECB:
  - Increase in the average maturity of outstanding liquidity;
  - Forward guidance;
  - Several asset purchase programmes;
  - Negative deposit facility rates.

- Estimation spans from 1999Q1 to 2017Q2.
Shadow rate and key ECB interest rates
The impulse responses to a monetary policy shock

The black line is the mean impulse response associated with the model estimated over the period 1999Q1-2007Q4 and the gray area is its 90 percent confidence region. The orange line is the mean impulse response associated with the model estimated over the period 1999Q1-2017Q2.
Observed series and counter-factual estimate
Year-on-year output growth and inflation rates

### Output growth

- **Observed**
- **Counterfactual**
- **90% confidence interval**

### Inflation

- **Observed**
- **Counterfactual**
- **90% confidence interval**
Empirical results

Quantifying the macroeconomic effects of unconventional policies, we find that:

- Without unconventional measures, the euro area would have suffered:
  - A cumulative loss of output of around 52% of its pre-crisis level over the period 2008Q1-2017Q2;
  - Deflation episodes from mid-2015 to early 2017.

- This translates into year-on-year inflation and GDP growth that would have been on average about 0.66% and 0.98% below their actual levels over the period 2014Q1-2017Q2, respectively.
Robustness

Unconventional policy gains from alternative shadow rates (percent)

Percentage gain: using the shadow rate extracted from the common factor (Black), averaging results obtained using four shadow rates (Blue dotted). On each box: central mark (median), the bottom (25th perc.) & top (75th perc.) edges, '+' symbol (outliers).
Comparative study I

The case of the US

Annualised nominal interest rate

-3 -2 -1 0 1 2 3 4

Observed
Counterfactual
Comparative study II
The case of the US
Conclusion

- Through the lens of a DSGE model, we include a shadow rate to study the effects of unconventional monetary policies in the euro area.

- This shadow rate is derived as the first principal component of a set of alternative shadow rates and is used as a summary measure of the overall stance of monetary policy.

- Counter-factual analysis is conducted to study the state of the economy in the absence of the ECB’s unconventional policies.

- We find that these policies have had positive macroeconomic effects, notably on output and prices.
Thank you for your attention!
# Cumulative loss

## Table 2. Cumulative loss

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<tr>
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<tbody>
<tr>
<td>Output</td>
<td></td>
<td>52.29</td>
<td>10.97</td>
<td>41.32</td>
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<tr>
<td>Consumption</td>
<td></td>
<td>19.28</td>
<td>3.47</td>
<td>15.81</td>
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<tr>
<td>Investment</td>
<td></td>
<td>89.25</td>
<td>19.31</td>
<td>69.94</td>
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<td>Hours worked</td>
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<td>48.66</td>
<td>10.53</td>
<td>38.13</td>
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<tr>
<td>Real wage</td>
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<td>20.01</td>
<td>3.91</td>
<td>16.10</td>
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<tr>
<td>Price level</td>
<td></td>
<td>21.65</td>
<td>2.52</td>
<td>19.13</td>
</tr>
</tbody>
</table>

*Note:* The cumulative loss associated with the variable $x_t$ is \( \sum \left( \frac{x_t^c}{x_t^o} - 1 \right) \), where $x_t^o$ is the observed level and $x_t^c$ is the counterfactual.
Literature

- Macro effects of UMPs:
  - Overall measures: Engen, Laubach and Reifschneider (2015) and Wu and Xia (2016).