ECB Monetary Policy Announcements' Effect on Private Sector Expectations

TILBURG UNIVERSITY

Gergana Markova

EME UvT

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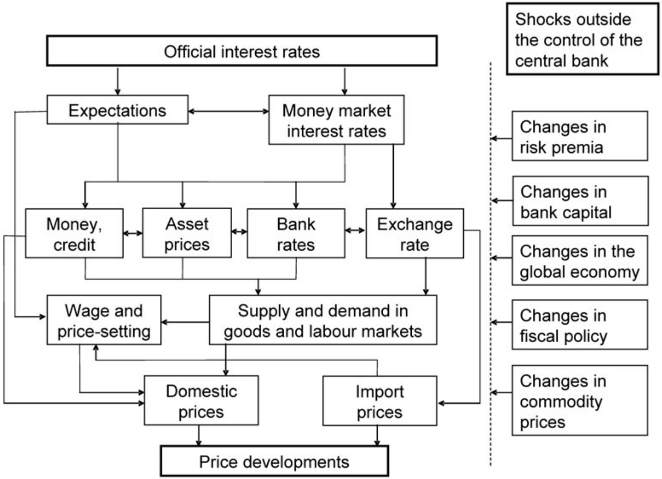
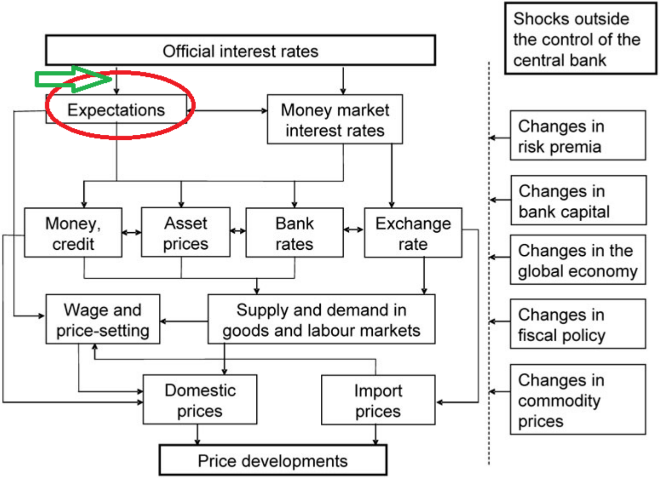
Central Banks - the only game in town?

- In recent years we observe a wider range of instruments employed by the ECB to achieve its objective
- Programs such as the PSPP are causing concerns related to the ECB overstepping its mandate
- COVID-19 times: ECB's *strategy* stands on a par with fiscal measures implemented by the EA governments
- Even more vital nowadays to understand the impact of ECB's policy on inflation and the real economy

Monetary Policy Transmission Channels



Monetary Policy Transmission Channels



Monetary Policy Transmission Channels: Forward Guidance

non-conventional monetary policy instrument: ECB is providing information about its future monetary policy

credibility of the central bank is key for proper forward guidance

FG by ECB was first officially introduced in July 2013

communication about future monetary policy intentions helps banks, financial market participants, businesses and consumers have a better understanding of how borrowing costs are likely to develop in the future and helps to give the economy the kick-start it needs.

Monetary Policy Transmission Channels: Forward Guidance

Odyssean FG publicly commits the CB to a future action

Delphic FG forecasts macroeconomic performance and likely monetary policy actions

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Datasets used

Main question: how do ECB's **monetary policy announcements (FG)** affect **private sector expectations**

Monetary Policy Announcements: data taken from The Euro Area Monetary Policy Event-Study Database (EA-MPD)

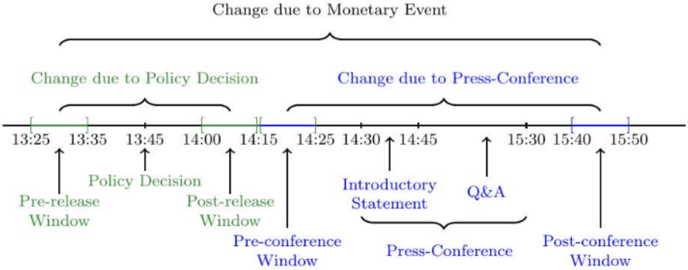
Private Sector Expectations: for real GDP, inflation, and unemployment rate are measured by the ECB Survey of Professional Forecasters

EA-MPD: Measuring euro area monetary policy

- ECB communicates its policy decision using a press release, at 13:45 CET, often followed by a press conference, at 14:30 CET (two separate time windows)
- Take the changes of asset prices between the median price in pre-press-release window (13:25-13:35), the median price in the post-press-release window (14:00-14:15) → press-release monetary policy shock
- Similiarly, the difference between the median price in pre-conference interval (14:15-14:25) and the median price of the post-conference window (15:40-15:50) → conference monetary policy shock
- Asset prices include the OIS rates with 1, 3, 6 month, 1 to 10, 15 and 20 year maturities; German, French, Italian, and Spanish sovereign yields with different maturities, the STOXX50E and the stock price index comprising banks (SX7E), and the exchange rate of the euro

EA-MPD: Measuring euro area monetary policy

Figure 1: ECB policy communication timeline



Note: The figure shows the typical policy communication structure during a day of the Governing Council policy meeting of the ECB.

EA-MPD: Measuring euro area monetary policy

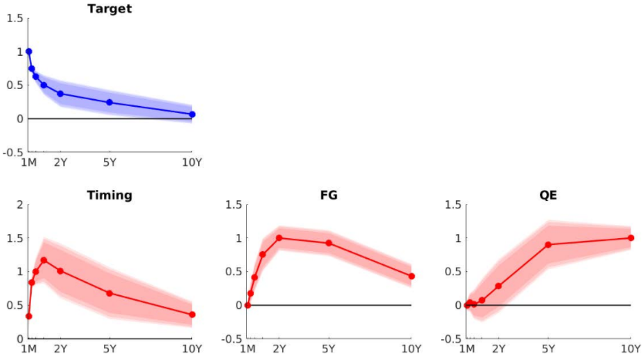
Table 3: Relative contribution of factors in explaining policy surprises, full sample

	1-month	3-month	6-month	1-year	2-year	5-year	10-year	SD Factor
Press release								
Target	97.8	91.3	82.7	60.4	32.9	11.9	1.5	2.2
Residual	2.2	8.7	17.3	39.6	67.1	88.1	98.5	
SD OIS	2.2	1.7	1.5	1.4	1.4	1.5	1.2	
Conference								
Timing	54.7	86.6	70.3	50.1	29.5	14.8	9.7	2.3
Forward Guidance	0.0	9.0	28.1	48.9	68.0	64.2	33.2	3.6
QE	0.0	0.2	0.0	0.1	1.7	18.7	53.8	2.0
Residual	45.3	4.2	1.6	0.9	0.8	2.3	3.3	
SD OIS	1.1	2.1	2.8	3.9	4.4	4.1	2.7	

Note: The table reports, for the maturity of the OIS rates reported in the first row, the fraction of the variance (in percentage points) explained by Target factor in the press release window and by each of the three factors (Timing, Forward Guidance, and QE) in the conference window. The row labeled "Residual" reports the variance not explained by the factors. The last row in each panel shows the variance of the OIS rate at the relevant maturity measured in the release and conference window respectively. The last column reports the standard deviations of the four factors.

EA-MPD: Measuring euro area monetary policy

Figure 3: Factor loadings



Note: The figure shows the factor loadings for the press release (first row) and the conference windows (second row), in basis points. In each window, for each maturity the loadings are obtained by regressing the surprises onto the factors also controlling for the standardized surprise associated with the release of the US initial jobless claims. The Target and the Timing factors are normalized to have unit effect on the 1-month and 6-month OIS, respectively. The Forward Guidance and QE factors are normalized to have unit effect on the 2-year and on the 10-year yields, respectively. The shaded areas indicate the 90%, 95% and 99% confidence intervals.

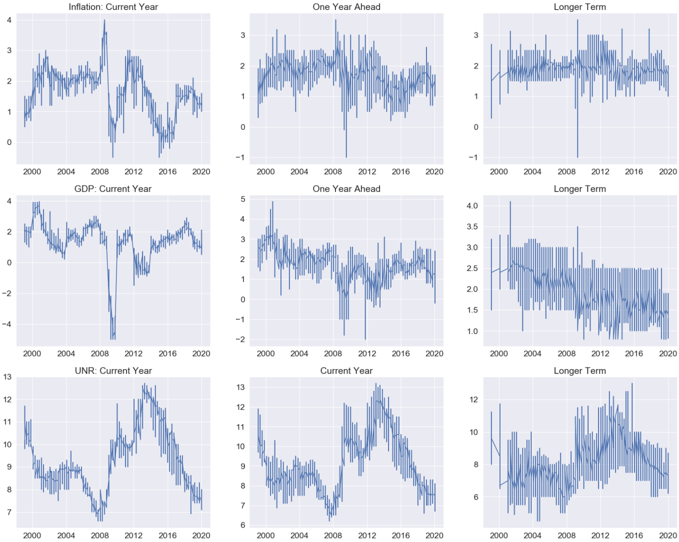
EA-MPD: Measuring euro area monetary policy

- The efficient market hypothesis (EMH) or theory states that asset prices reflect all information.
- From EMH it follows that the pre- press and conference prices already contained all possible information related to the state of the economy, other than the ECB announcement.
- Therefore the asset price changes in EA-MPD are the true monetary policy surprise shocks, and are orthogonal to all other economic news, that were known before the announcements.

SPF: Measuring expectations

- SPF collects information on the expected rates of inflation, real GDP growth and unemployment in the euro area at several horizons, ranging from the current year to the longer term
- Includes both point forecasts and probability distributions
- Began in 1999, collected four times a year (each quarter) from more than 120 different sources
- Forecasts provided are **yearly** forecasts for the current year, one year ahead forecast, longer term, rolling yearly growth rate of the **quarter** three quarters ahead and seven quarters ahead

SPF: Measuring expectations



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Model set-up

- We want to study the change in expectations, hence we need the difference in SPF forecasts
- **However the difference no longer refers to the same variable**
- ex: in the 2009Q1 forecast, the monetary policy surprise (MPS) was affecting the forecast for all four quarters of 2009, but in the 2009Q4 forecast - only one
- We need to break down the yearly forecasts into quarters **while keeping in mind the different horizons: current year, one year ahead, rolling quarter three quarters ahead, rolling quarter seven quarters ahead**

Model set-up: not all quarters are equal

We can easily derive that not all quarters have the same effect for the yearly growth of the variable:

$$g_y = \frac{1}{4}g_{Qt} + \frac{1}{2}g_{Qt-1} + \frac{3}{4}g_{Qt-2} + g_{Qt-3} + \frac{3}{4}g_{Qt-4} + \frac{1}{2}g_{Qt-5} + \frac{1}{4}g_{Qt-6} + 0g_{Qt-7} \tag{1}$$

where g_{Qt} is the growth rate of the last quarter of the second year.

- Assume that a monetary policy announcement takes place in April, 2018, and causes a total change in the annual forecast c_y.
- The total change c_y that we observe is in fact a linear combination of the quarterly responses of private forecasters' to the monetary policy announcement c_j (where $j = 0...7$ for each quarter)
- The announcement will then shift only the remaining three quarters of 2018 and the effect on the average annual growth for 2018 compared to 2017 c_y will be equal to $c_y = \frac{3}{4}c_0 + \frac{1}{2}c_1 + \frac{1}{4}c_2$

Model set-up: not all quarters are equal

$$c_y = \begin{bmatrix} 0 & \frac{1}{4} & \frac{1}{2} & \frac{3}{4} & 1 & \frac{3}{4} & \frac{1}{2} & \frac{1}{4} \\ \frac{1}{4} & \frac{1}{2} & \frac{3}{4} & 1 & \frac{3}{4} & \frac{1}{2} & \frac{1}{4} & 0 \\ \frac{1}{2} & \frac{3}{4} & 1 & \frac{3}{4} & \frac{1}{2} & \frac{1}{4} & 0 & 0 \\ \frac{3}{4} & 1 & \frac{3}{4} & \frac{1}{2} & \frac{1}{4} & 0 & 0 & 0 \\ 1 & \frac{3}{4} & \frac{1}{2} & \frac{1}{4} & 0 & 0 & 0 & 0 \\ \frac{3}{4} & \frac{1}{2} & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 \\ \frac{1}{2} & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & 0 \\ \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} c_0 \\ c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \\ c_7 \end{bmatrix} \tag{2}$$

Model set-up: not all quarters are equal

- The model uses the first difference of all consecutive forecasts as a proxy for a change in the expectations of the private sector and the change in the 2 year OIS as a measure for the monetary policy shock (FG).
- Let's look at the difference between the current calendar year forecasts for 2003 submitted in 2003Q2 and 2003Q1.

$$\Delta CY = \Delta f2003Q1 + \frac{3}{4}\Delta f2003Q2 + \frac{1}{2}\Delta f2003Q3 + \frac{1}{4}\Delta f2003Q4 + \epsilon \tag{3}$$

where ϵ captures the forecast error for 2002Q4, and the rest of the right-handed side is the change in expectations that happened between the two forecast rounds.

- Then $\Delta CY = \frac{3}{4}c_0 MPS + \frac{1}{2}c_1 MPS + \frac{1}{4}c_2 MPS + \epsilon_1$

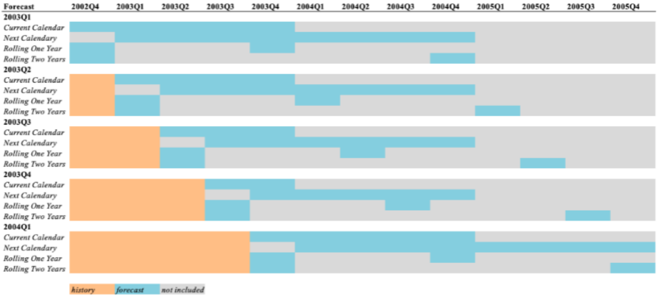
Model set-up: timetable

Table 1: Timetable for the 2003-2004 period

Forecast	Deadline to reply	Last Data Available	Monetary Event
2003Q1	27.01.03	2002Q3	
			06.02.2003
			06.03.2003
			03.04.2003
2003Q2	24.04.03	2002Q4	
			08.05.2003
			05.06.2003
			10.07.2003
2003Q3	23.07.03	2003Q1	
			31.07.2003*
			04.09.2003
			02.10.2003
2003Q4	28.10.03	2003Q2	
			06.11.2003

Model set-up: forecasts

Figure 1: Forecasted Quarters 2003Q1-2004Q1



Model set-up: final model

$$
\begin{aligned}
\Delta NY_{Q1} &= 0c_0 MP + \frac{1}{4}c_1 MP + \frac{1}{2}c_2 MP + \frac{3}{4}c_3 MP + c_4 MP + \frac{3}{4}c_5 MP + \frac{1}{2}c_6 MP + \frac{1}{4}c_7 MP + \epsilon_1 \\
\Delta NY_{Q2} &= \frac{1}{4}c_0 MP + \frac{1}{2}c_1 MP + \frac{3}{4}c_2 MP + c_3 MP + \frac{3}{4}c_4 MP + \frac{1}{2}c_5 MP + \frac{1}{4}c_6 MP + \epsilon_2 \\
\Delta NY_{Q3} &= \frac{1}{2}c_0 MP + \frac{3}{4}c_1 MP + c_2 MP + \frac{3}{4}c_3 MP + \frac{1}{2}c_4 MP + \frac{1}{4}c_5 MP + \epsilon_3 \\
\Delta NY_{Q4} &= \frac{3}{4}c_0 MP + c_1 MP + \frac{3}{4}c_2 MP + \frac{1}{2}c_3 MP + \frac{1}{4}c_4 MP + \epsilon_4 \\
\Delta CY_{Q1} &= c_0 MP + \frac{3}{4}c_1 MP + \frac{1}{2}c_2 MP + \frac{1}{4}c_3 MP + \epsilon_5 \\
\Delta CY_{Q2} &= \frac{3}{4}c_0 MP + \frac{1}{2}c_1 MP + \frac{1}{4}c_2 MP + \epsilon_6 \\
\Delta CY_{Q3} &= \frac{1}{2}c_0 MP + \frac{1}{4}c_1 MP + \epsilon_7 \\
\Delta CY_{Q4} &= \frac{1}{4}c_0 MP + \epsilon_8 \\
\Delta RY_{1Y} &= c_3 MP + \epsilon_9 \\
\Delta RY_{2Y} &= c_7 MP + \epsilon_{10}
\end{aligned}
\tag{4}
$$

Model set-up: final model

- We have a system of ten equations and only eight variables to identify ($c_0 ... c_7$), which results in the model being **over-identified**

$$y_i = xA_i c_i D_i + \epsilon_i \tag{5}$$

- We can then easily derive the following moment conditions:

$$E[xDi|\epsilon_i] = 0 \tag{6}$$

$$E[xDi|(y_i - xA_i c_i Di)] = 0 \tag{7}$$

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Econometric Approach

Generalized Method of Moments (GMM) overview

- Matches some defined moments to the observed data
- Unlike MLE, does not require knowledge of the distribution of the data
- Even if the distribution is known, GMM can be computationally easier to estimate compared to MLE
- When the model is **overidentified** (we have more moment conditions than parameters to estimate), GMM provides a way to test the specification of the model

(Generalized) Method of Moments: GMM

We define

- **data** w_i (e.g. $w_i = (y_i, x_i)^T$), sample size n
- **parameters** to estimate $\theta \in \Theta \subseteq R^p$; the estimator θ_0 solves
- **moment conditions** $g(w_i, \theta) : R^p \rightarrow R^k$ s.t.

$$Eg(w_i, \theta) = 0 \tag{8}$$

e.g. in the OLS subcase (moment conditions estimator since it's just identified):

$$g(w_i, \theta) = x_i(y_i - \theta x_i) = \epsilon \tag{9}$$

$$E[x_i \epsilon] = 0 \tag{10}$$

(Generalized) Method of Moments: GMM

The GMM estimator minimizes wrt θ:

$$Q_n(\theta) = \left[\frac{1}{n}\sum_{i=1}^{n} g(w_i, \theta)\right]^T W_n \left[\frac{1}{n}\sum_{i=1}^{n} g(w_i, \theta)\right] \tag{11}$$

- where W_n is a $k \times k$ weighing symmetric positive definite matrix
- W_n is estimated using iterative GMM in order to achieve efficiency of the estimator

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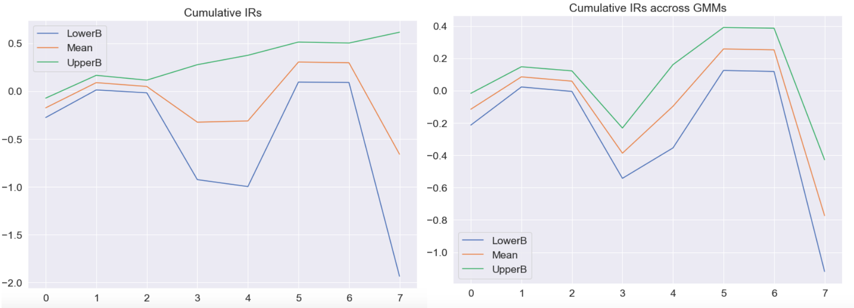
Real GDP results

mpGMM Results

Dep. Variable:	GDP forecast diff	Hansen J:	3.329
Model:	mpGMM	Prob (Hansen J):	0.189
Method:	GMM		
Date:	Mon, 20 Jul 2020		
Time:	01:59:26		
No. Observations:	71		

	coef	std err	z	P>|z|	[0.025	0.975]
c0	-0.1735	0.052	-3.353	0.001	-0.275	-0.072
c1	0.2635	0.086	3.070	0.002	0.095	0.432
c2	-0.0402	0.016	-2.518	0.012	-0.071	-0.009
c3	-0.3732	0.310	-1.205	0.228	-0.980	0.234
c4	0.0128	0.633	0.020	0.984	-1.227	1.253
c5	0.6158	0.407	1.513	0.130	-0.182	1.414
c6	-0.0074	0.004	-1.654	0.098	-0.016	0.001
c7	-0.9565	0.669	-1.431	0.152	-2.267	0.354

Real GDP results

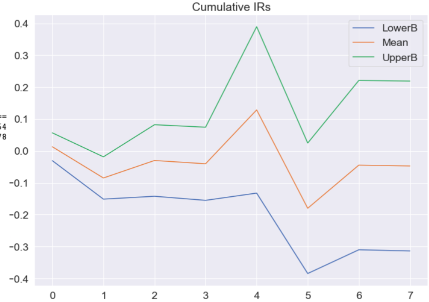


Inflation results

mpGMM Results

Dep. Variable:	Inflation forecast diff	Hansen J:	2.564
Model:	mpGMM	Prob (Hansen J):	0.278
Method:	GMM		
Date:	Mon, 20 Jul 2020		
Time:	01:57:11		
No. Observations:	71		

	coef	std err	z	P>|z|	[0.025	0.975]
c0	0.0130	0.022	0.583	0.560	-0.031	0.057
c1	-0.0979	0.051	-1.902	0.057	-0.199	0.003
c2	0.0549	0.076	0.724	0.469	-0.094	0.203
c3	-0.0103	0.003	-3.630	0.000	-0.016	-0.005
c4	0.1689	0.183	0.925	0.355	-0.189	0.527
c5	-0.3084	0.193	-1.595	0.111	-0.687	0.071
c6	0.1353	0.196	0.691	0.490	-0.248	0.519
c7	-0.0027	0.001	-2.067	0.039	-0.005	-0.000



Unemployment results

mpGMM Results

Dep. Variable:	Unemployment forecast diff	Hansen J:	0.3303
Model:	mpGMM	Prob (Hansen J):	0.848
Method:	GMM		
Date:	Tue, 14 Jul 2020		
Time:	14:27:27		
No. Observations:	51		

	coef	std err	z	P>|z|	[0.025	0.975]
c0	0.0621	0.036	1.744	0.081	-0.008	0.132
c1	-0.1628	0.074	-2.204	0.028	-0.308	-0.018
c2	0.1790	0.057	3.135	0.002	0.067	0.291
c3	-0.0016	0.007	-0.224	0.823	-0.016	0.013
c4	0.1279	0.147	0.869	0.385	-0.161	0.416
c5	-0.6736	0.252	-2.674	0.007	-1.167	-0.180
c6	0.7456	0.186	4.010	0.000	0.381	1.110
c7	0.0022	0.008	0.256	0.798	-0.014	0.019