Cross-country Effects of ECB Asset Purchase Programs

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[1] Disclaimer: the views expressed in this presentation are those of the author and do not necessarily reflect the views of Federal Reserve System

Introduction

- Asset purchases have become a policy tool among Central Banks since 2009
- The ECB's Asset Purchase Programs:
  1. **Jan. 2015 - Dec. 2018 / Sep. 2019 - Jun. 2022**: Expanded Asset Purchase Program (EAPP)
  2. **Mar. 2020 - Apr. 2022**: Pandemic Emergency Purchase Program (PEPP)
- Total purchases: 5.2 trillions, **40%** of Euro Area GDP in 2022:Q2

Research Questions

- What are the **macroeconomic effects** of the EAPP and the PEPP on the Euro Area?
- Are these effects heterogeneous among European countries?

Methodology

- Factor- Augmented Vector Autoregressive model with Stochastic Volatility and Time-varying Parameters (TVP-SV-FAVAR)
- 219 time series of Germany, France, Italy, Spain, and the Euro Area
- Identification is achieved through a proxy variable for APP surprises in the spirit of Gambetti and Musso (2020) and sign and zero restrictions
- Time variation in the model is advocated by:
  1. Economic and institutional framework changed between APP and PEPP
  2. Proxy of APP surprises shows significant time-varying volatility

Preview of Results

1. All channels of transmission of QE were active for the Euro Area
2. Significant heterogeneity in the responses of European countries:
    - Southern European economies: largest decrease in government yields but smallest decrease in retail lending rates
    - Cross-country differences in the responses of interest rates reduced over time
    - Inflation increased more in Germany and Spain than in France and Italy
    - Unemployment decreased more in Italy and Spain than in Germany and France

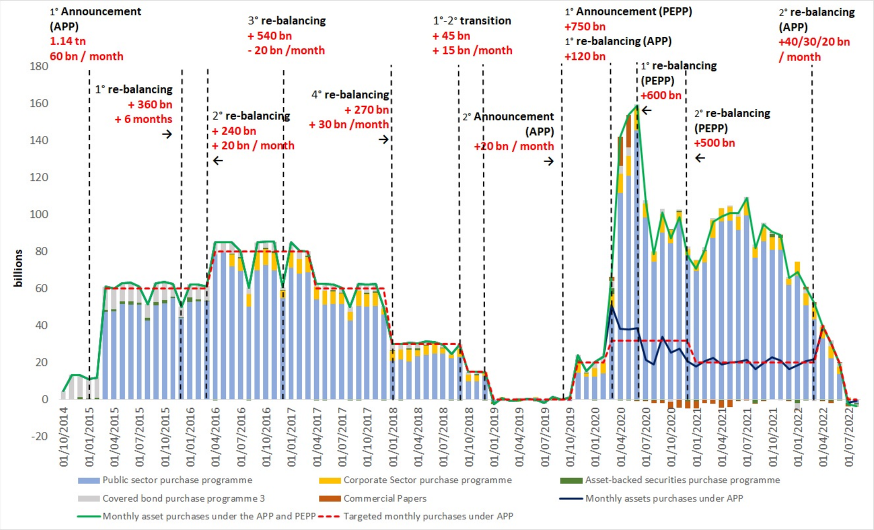
Literature

- Large literature on the effects of QE for the US and the UK
  Borio and *Zabai* (2015)
- Short term financial effect in Europe
  Altavilla et al. (2019), *De Santis* (2016); *Eser at al.* (2019), *Moessner* and *De Haan* (2022)
- Macroeconomic effects of APP on the aggregate of the EA
  Wieladek and *Garcia Pascual* (2016), *Gambetti* and *Musso* (2020), *Lhuissier and Nguayen* (2021)
- Heterogeneous effects of unconventional monetary policies
  Buriel and *Galesi* (2016), *van der Zwan et al.* (2021)
- DFM and FAVAR literature
  Bernanke et al. (2005), *Forni et al.* (2010)
  studying responses to MP in Europe:
  Barigozzi et al. (2014), *Corsetti et al.* (2022)

Contributions

- Assessment of heterogeneities in the macroeconomic effects of Asset Purchases across countries
- The large dimension of the model accounts for potential non-fundamentalness that may affect lower scale models (i.e. SVARs)
- Extension to Covid-19 period (PEPP)
- Time-variation allows to separately identify the effects for different episodes (first announcements vs adjustments)

ECB purchases under APP and PEPP



Proxy for APP surprises

- Most of the announcements were correctly anticipated by the market
- Let a_t be the announced total size of purchases

$$a_t = E_t(a_t) + \psi_t$$

- Use newspaper articles to approximate $E_t(a_t)$ around policy announcements and retrieve ψ_t

Proxy for APP surprises - II

- *"The ECB is expected to buy 550 billions of government debt, analysts polled by Bloomberg earlier this week said"*

  Financial Times, January the 21^{st} 2015

- January the 22^{nd} the ECB launched a 1.1 tn purchase program
- $E_{1:15}(a_{1:15}) = 550$ bn, $a_{1:15} = 1.1$ tn,
  $\psi_{1:15} = a_{1:15} - E_{1:15}(a_{1:15}) = 550$ bn
- According to this methodology ψ_t takes values:

$$\psi_t = 550 \quad billions \quad if \quad t = 01:2015$$
$$\psi_t = 120 \quad billions \quad if \quad t = 03:2016$$
$$\psi_t = 570 \quad billions \quad if \quad t = 03:2020$$
$$\psi_t = 100 \quad billions \quad if \quad t = 06:2020$$
$$\psi_t = -120 \quad billions \quad if \quad t = 12:2015$$
$$\psi_t = -90 \quad billions \quad if \quad t = 12:2016$$
$$\psi_t = +? \quad billions \quad if \quad t = 09:2019$$
$$\psi_t = 0 \qquad if \quad t \neq 01:2015, 03:2016, 03:2020, 06:2020$$

TVP-SV-FAVAR model

Let y_t be a vector of variables used for identification and x_t a panel of n time series

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} I & 0 \\ \Lambda_y & \Lambda_f \end{bmatrix} \begin{bmatrix} y_t \\ f_t \end{bmatrix} + \begin{bmatrix} 0 \\ \eta_t \end{bmatrix} \quad (1)$$

$$\begin{bmatrix} y_t \\ f_t \end{bmatrix} = c_t + B_t(L) \begin{bmatrix} y_{t-1} \\ f_{t-1} \end{bmatrix} + \nu_t \quad (2)$$

$$\beta_t = \beta_{t-1} + \epsilon_t \quad (3)$$

$$\eta_t \sim N(0, \Sigma_\eta) \qquad \nu_t \sim N(0, \Sigma_{\nu,t}) \qquad \epsilon_t \sim N(0, Q)$$

- $\beta_t = [c_t, vec(B_t), vec(B_{t-1}), ...vec(B_{t-p+1})]$
- Σ_η and Q diagonal
- $A_t \Sigma_{\nu,t} A_t' = \Omega_t \; \Omega_t'$. Standard assumptions on elements of A_t and Ω_t hold

IRFs

Identification

Set identification of EAPP and PEPP shocks

- **EAPP**. Exploit institutional characteristics of the announcements: purchases starting few months after the announcement

  (*Gambetti and Musso*, 2020)

- **PEPP**. Identification requires additional assumptions because:
  1. Purchases started contemporaneously to announcements
  2. PEPP was a contemporaneous response to COVID

- For **PEPP** assumes that *Portfolio Re-balancing* and *Reduction in Volatility* channels were active

  (*Wieladek et al.*, 2016 and *van der Zwan et al.*, 2021)

Identification - II

- Define $y_t = [z_t \quad \psi_t]'$

  z_t: monthly purchases for monetary policy purposes

- Summary of contemporaneous identifying restrictions

	EAPP	**PEPP**
z_t	0	?
ψ_t		$+$
$SP_{i,t}$		$+$
$10y_{i,t}$		-
VIX_t		-

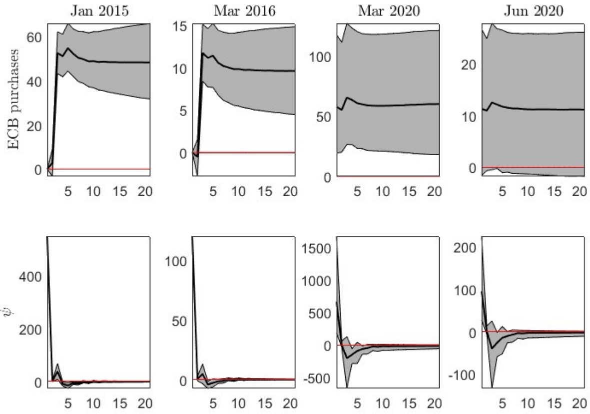
with $i = \{EA, \ DE, \ SP, \ IT, \ FR\}$

Data and Estimation

- x_t includes 219 monthly time series covering the Euro Area and the four largest European economies from 2009:m1 to 2022:m6
- The model is estimated with 7 factors and 3 lags (54% of total variance, 61% of variance of variables of interest)
- Two-step estimation:
  1. Extract static factors using PCA
  2. Conditional on factors, estimation of the model is Bayesian (50.000 draws, first 20.000 are burnt in)

MCMC

IRFs of y_t to APP and PEPP shocks

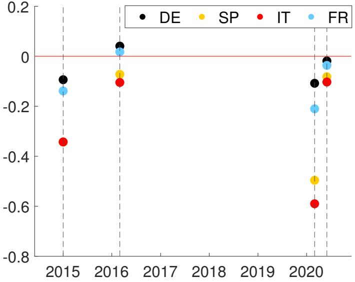


▸▸ SV

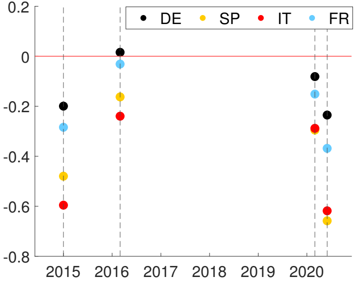
▸▸ EA

Heterogeneous effects on government bond yields

Maximum median response



a) 2-year yield



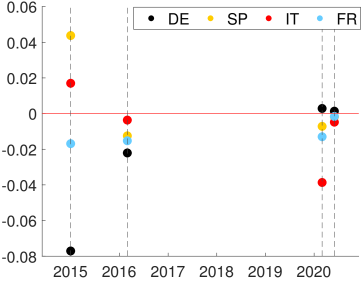
b) 10-year yield

- Italian and Spanish bond yields declined more than German and French in response to announcements

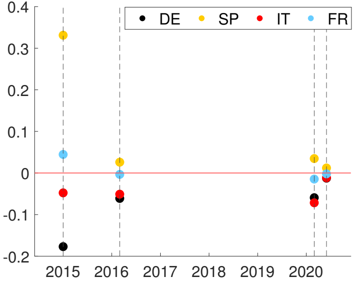
10y

Heterogeneous effects on lending rates

Maximum median response



a) loan rate on new mortgages



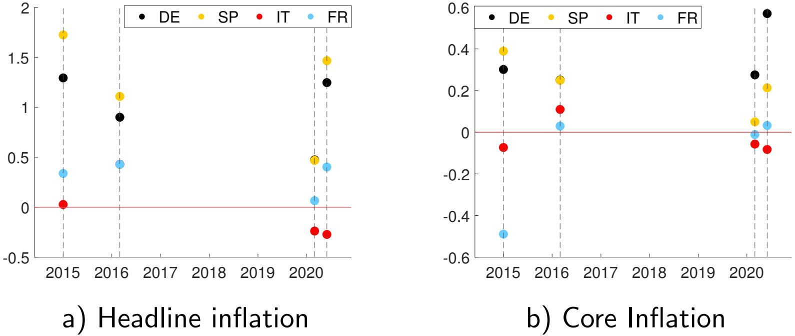
b) loan rate on new credit to NFC

- Interest rates on retail credit declined the most in Germany
- Cross-country differences became milder with later packages of purchases

NFC

Heterogeneous effects on inflation

Maximum median response

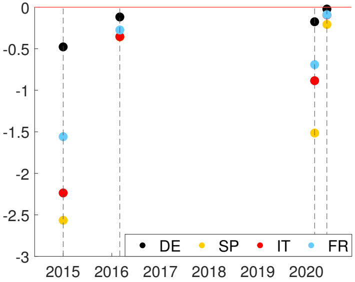


- The Inflation-anchoring channel has been stronger for Germany and Spain

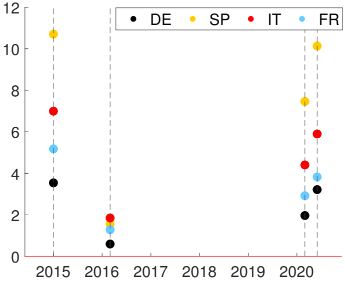
HCPI

Heterogeneous effects on unemployment

Maximum median response



a) Unemployment rate



b) Consumer Confidence

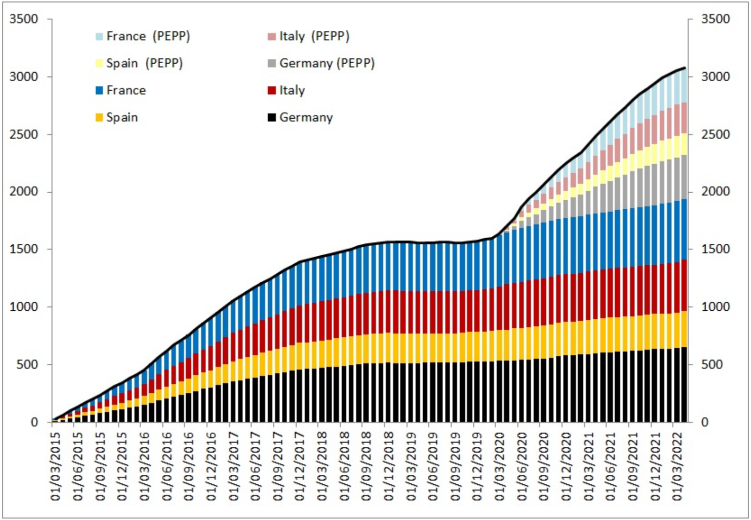
- Unemployment decreased more and confidence increased more in Spain and Italy

UNEMP

Conclusions

- Study the effects of the APP and EAPP on the EA with a specific focus on heterogeneous effects among European countries
- Estimate a TVP-SV-FAVAR for a large panel of time series
- Identify the APP and PEPP shocks using a proxy variable for APP surprises
- I show that:
  1. All channels of transmission of QE were active for the EA
  2. Significant heterogeneity in the responses of European countries:
     - Southern European economies: largest decrease in government yields but the smallest decrease in retail lending rates
     - Cross-country differences in the responses of interest rates reduced over time
     - Inflation increased more in Germany and Spain
     - Unemployment decreased more in Italy and Spain than in Germany and France

Public Sector Purchases by Country



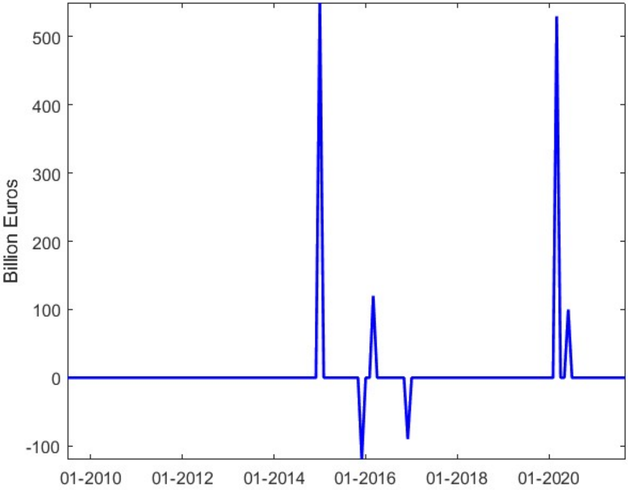


Figure: Proxy of APP announcements surprises, ψ_t

IRFs analysis

$$\begin{bmatrix} y_t \\ f_t \end{bmatrix} = D_t(L)^{-1} R u_t \tag{4}$$

- $u_t = (S_t H')^{-1} \nu_t$ is a vector of structural shocks
- $R = S_t H$, where S_t lower triangular s.t. $S_t S_t' = \Sigma_{\nu,t}$ and H is orthogonal

The representation of x_t and y_t in terms of structural shocks is:

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \underbrace{\begin{bmatrix} I & 0 \\ \Lambda_y & \Lambda_f \end{bmatrix}}_{\Lambda} D_t(L)^{-1} R u_t + \begin{bmatrix} 0 \\ \eta_t \end{bmatrix}$$

back

Priors

- Priors for Λ_f and Λ_y and diagonal elements of Σ_η are:

$$\lambda_{i,0}|\sigma^2_{\eta,i,0} \sim N(0, I_r) \quad i = 1, ...n$$

$$\sigma^2_{\eta,i,0} \sim iGamma(\alpha, \gamma) \quad i = 1, ...n$$

$\alpha = 0.01$ and $\gamma = 0.01$.

- Priors on β_0 and $\Sigma_{\nu,0}$ are:

$$\beta_0 \sim N(\hat{\beta_{OLS}}, (\hat{V_{\beta_{OLS}}})$$

$$\Sigma_{\nu,0} \sim IW(\hat{\Sigma_0}, \rho)$$

where $\hat{\beta_{OLS}}$, $\hat{V}_{\beta_{OLS}}$ and $\hat{\Sigma_0}$ are OLS estimates over the whole sample.

- Priors on α_0, ζ_0, W, Ψ, Q are:

$$
\begin{aligned}
log\sigma_{\nu,0} &\sim N(log(\hat{\sigma_0}), I) \\
\alpha_0 &\sim N(\hat{\alpha_0}, \hat{V}_\alpha) \\
\Psi &\sim IW(\Psi_0, \rho_1) \\
W &\sim IW(W_0, \rho_2) \\
Q &\sim IW(Q_0, \rho_3)
\end{aligned}
$$

- $\hat{\alpha_0} = 0$ and $log(\hat{\sigma_0}) = 0$
- $\Psi_0 = \rho_1 \delta_1 \hat{V}_\alpha$, $W_0 = \rho_2 \delta_2$ and $Q_0 = \rho_3 \delta_3 \hat{V}_{\beta_{OLS}}$, with $\delta_1 = 0.05$, $\delta_2 = 0.05$,$\delta_2 = 0.001$, $\rho_1 = dim(\Psi) + 1$, $\rho_2 = dim(W) + 1$, $\rho_3 = dim(Q) + 1$.

Factor Estimate and MCMC

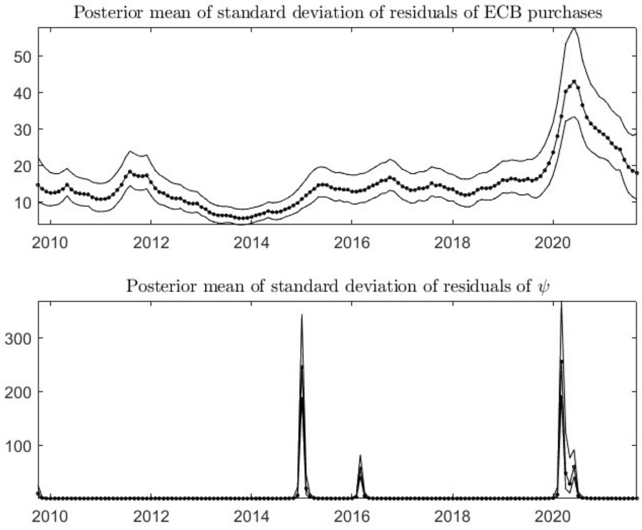
Two-step estimation:

1. Estimate static factors f_t using principal components
2. Conditional on f_t, perform the following MCMC:
   - 2.1 Draw λ_i from $p(\lambda_i|\sigma^2_{i,\eta})$. Since Σ_η is assumed to be diagonal, I draw coefficients λ_i separately for each variable in x_t.
   - 2.2 Draw $\sigma^2_{i,\eta}$ from $p(\sigma^2_{i,\eta}|\lambda_i)$
   - 2.3 Draw $\{1:\beta_t\}$ from $p(\{1:\beta_t\}|\Omega_{\nu,t}, A_t, \{1:f_t\})$ using the Carter-Khon algorithm.
   - 2.4 Draw elements of A_t from $p(A_t|\{1:\beta_t\}, \Omega_{\nu,t})$ and $\Omega_{\nu,t}$ from $p(\Omega_{\nu,t}|\{1:\beta_t\}, A_t)$

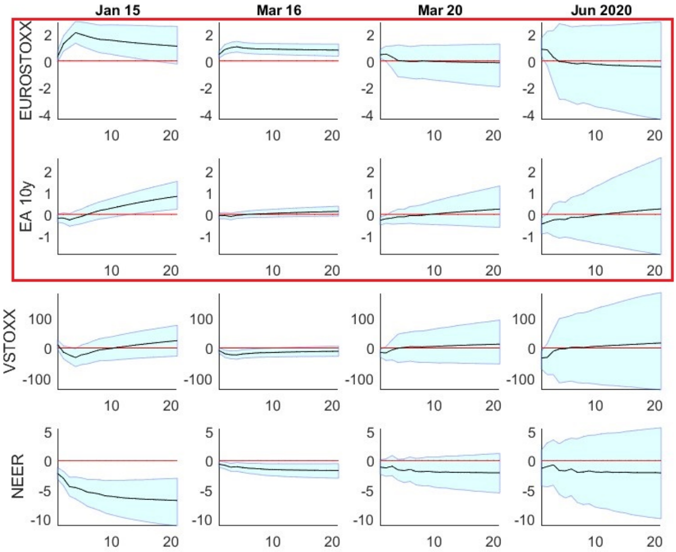
   Estimation is based on 50.000 draws (the first 20.000 are burnt in) of the Gibbs sampler.

back

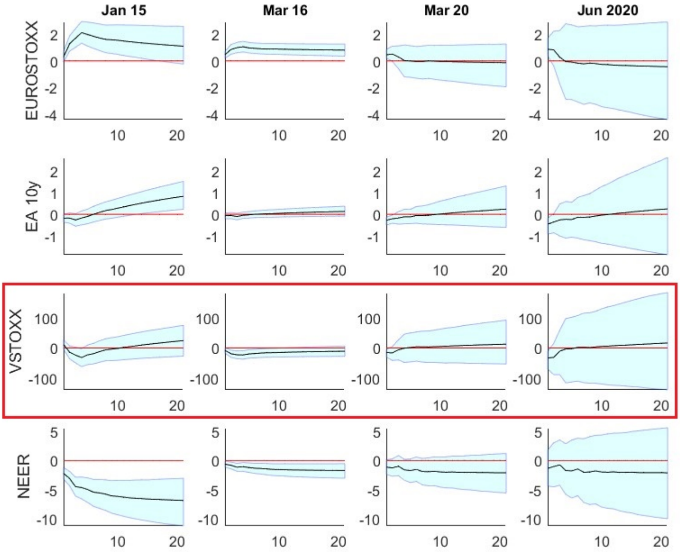
Estimated Standard Deviation of Residuals



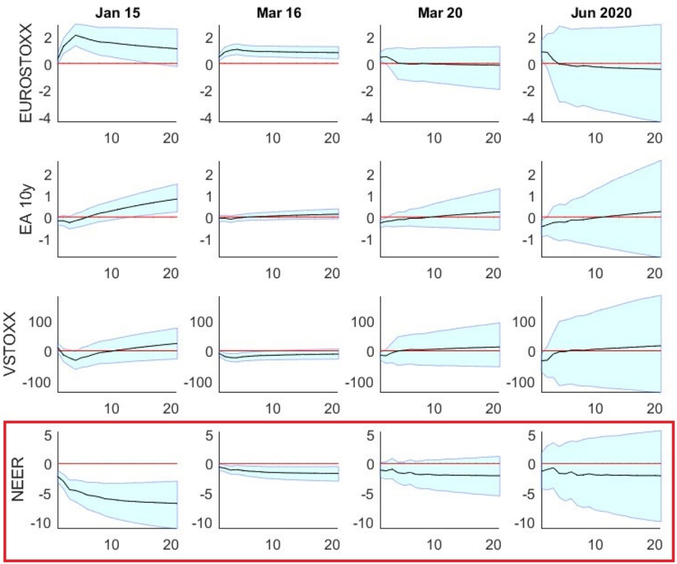
Portfolio Re-balancing Channel



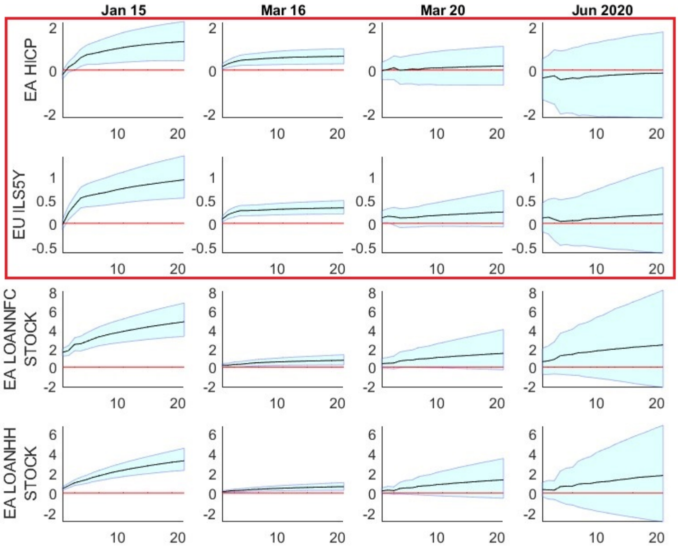
Reduction in Volatility Channel



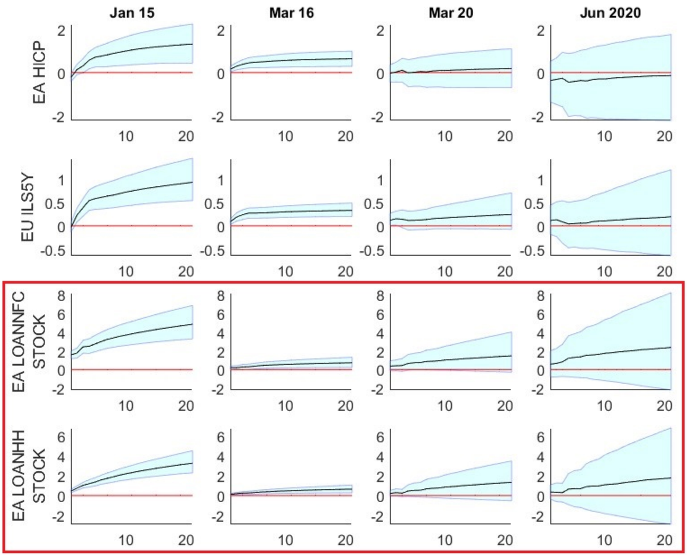
Exchange Rate Channel



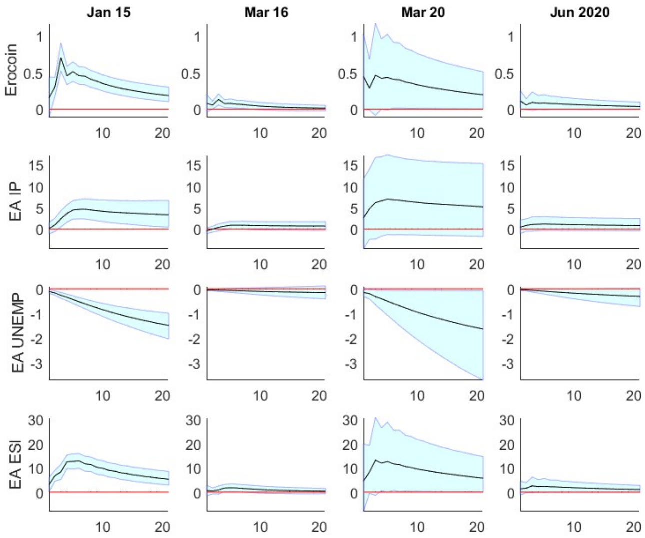
Inflation Anchoring Channel



Credit Easing Channel



Effects on Production and Labor Mkt



Heterogeneous effects on bond yields

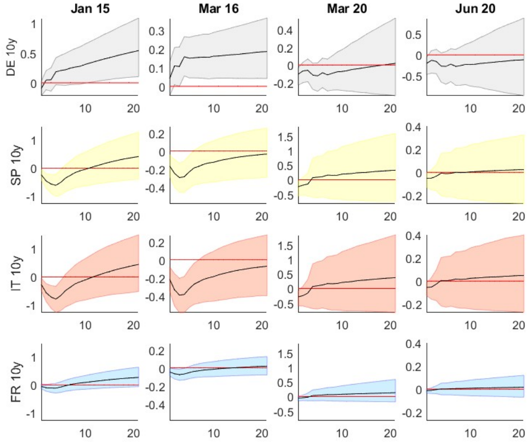


Figure: IRFs to an APP shock. Germany and countries differences with respect to Germany - 10-year government bond yield

Heterogeneous effects on lending rates

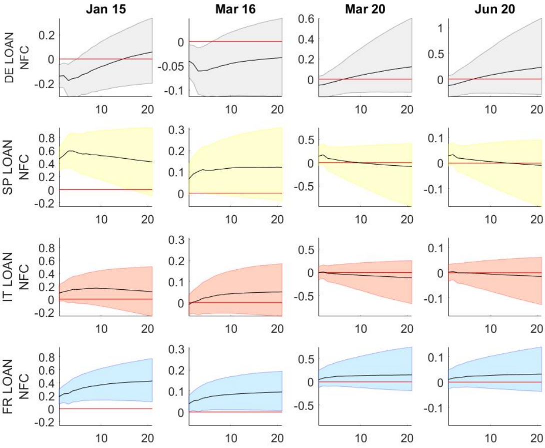


Figure: IRFs to an APP shock. Germany and countries differences with respect to Germany - lending rate to non-financial corporations

Heterogeneous effects on inflation

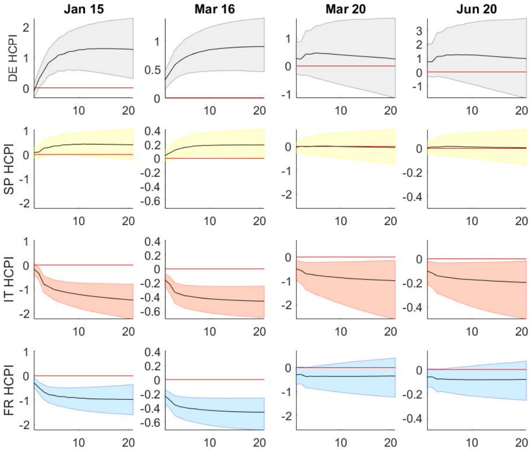


Figure: IRFs to an APP shock. Germany and countries differences with respect to Germany - Headline inflation

Heterogeneous effects on unemployment

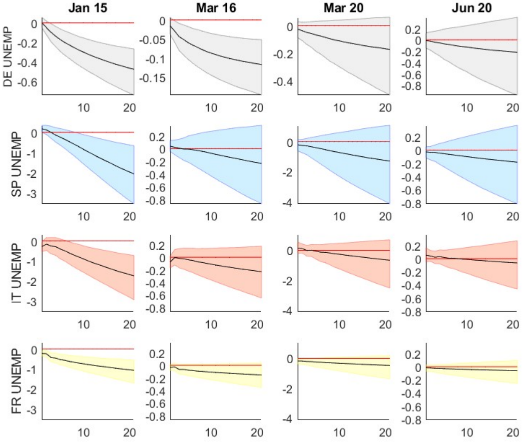


Figure: IRFs to an APP shock. Germany and countries differences with respect to Germany - Headline inflation