Nowcasting Inflation

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Abstract

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Introduction

This paper proposes a model for now-casting inflation for a selection of advanced economies and emerging markets which exploits weekly energy prices and, where available, other weekly variables.

The model is mixed frequency, including monthly inflation and inflation expectation data and real economy indicators as well as weekly energy indicators and food prices.

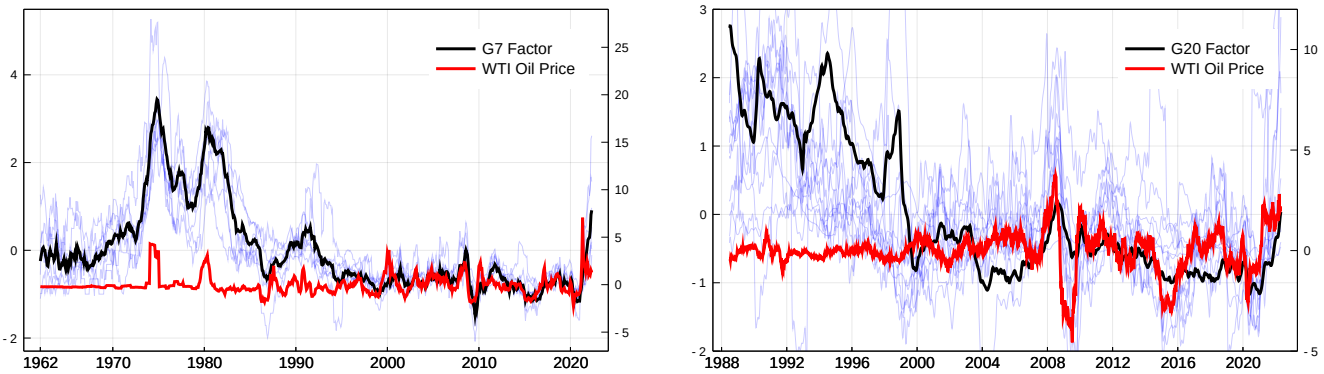
Energy prices in general are an important component of headline inflation and are available at higher frequency than inflation. Given their timeliness, they are an obvious input for a now-casting model. fiocusing on predicting the near term. Since oil prices are determined in the world market, they can be used as input in models for countries with scarce data availability.

Oil

The literature has documented that inflation dynamic is mainly explained by a low frequency component which is mostly determined by policy (CITE). When trend inflation is stable, however, inflation volatility is highly correlated with oil fluctuations.

In this paper we consider nine advanced economies (the G7 countries, Spain, Sweden and the euro area aggregate) and two emerging markets (Brazil and China) 0ver the sample 1985-2022.

The chart below shows WTI oil prices (in red) and CPI inflation for the GDP countries as well as their first common principle component (in light and dark blue respectively). On the right we plot the equivalent chart for the G20.



(a) G7 WTI deflazionato

(b) G70 WTI weekly

Figure 1: Intro

The clear message emerging from the chart is that when trend inflation is stable, oil prices and headline inflation are highly correlated and the volatility of inflation is mainly accounted for by oil prices. This is confirmed by a simple forecasting exercise

Table 1: Forecast exercise: VAR(3), 15 year rolling window

Evaluation Metric	Sample	Forecast Horizon											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
MAE	1973-1996	0.52	0.69	0.83	0.94	1.05	1.13	1.22	1.32	1.42	1.54	1.69	1.87
	1998-2022	**0.51**	0.69	**0.8**	**0.9**	**0.97**	**1.03**	**1.07**	**1.11**	**1.13**	**1.15**	**1.16**	**1.18**
RMSFE	1973-1996	0.45	0.69	0.98	1.31	1.74	2.2	2.87	3.96	5.51	7.81	11.22	16.22
	1998-2022	**0.36**	**0.66**	**0.91**	**1.15**	**1.36**	**1.54**	**1.67**	**1.8**	**1.92**	**2.01**	**2.06**	**2.11**

This suggests that a timely indicator of inflation in the current month and few months ahead can be built on the basis of weekly and widely available energy prices for many countries. When inflation is anchored, this global variable should be the driver of cyclical inflation although local economic conditions should also matter and indeed we use then when available at weekly frequency.

The paper has two objectives. The first is to design a now-casting model for inflation including weekly and monthly variables for both advanced and emerging economies. To that end we build on Banbura et al. and propose a novel time aggregation method in alternative to the widely used Mariano and Murasawa.

The second objective is to understand the role of energy prices in short term prediction of inflation distinguishing between the role of timeliness from that of intrinsic forecasting power. We do this by the mean of counterfactuals. To shed more light on this issue we also propose some case studies for the Us and the euro-zone focusing on the period arounds the great financial crisis and then covid.

The paper is organized as follows. In the first Section we briefly describe the methodology. In the second, we report the real time now-casting results. In the third, we describe the case studies.

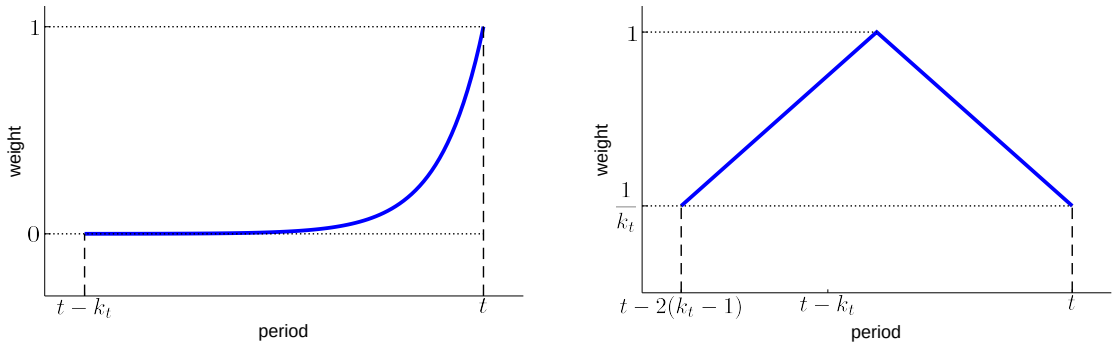
1 Methodology

1.1 Power Law Aggregation Scheme

Power law:

$$\gamma_i^{(j)} = \frac{1}{\gamma^i}, \quad i = 0, \ldots, k_j - 1 \;\; and \;\; \gamma > 1 \tag{1}$$

where k_j is the number of business weeks in the reference period and $j = \{q, m, w\}$.



(a) Power Law **(b)** Mariano Murasawa

Figure 2: Aggregation schemes.

1.2 State Space

Let $y_t^j = [y_{1,t}^{(j)}, y_{2,t}^{(j)}, \ldots, y_{n_j,t}^{(j)}]'$ with $t = 1, \ldots, T$ be a stationary zero mean and unit variance vector at j-frequency, where $j = \{q, m, w\}$. Standard dynamic factor model representation for the mixed frequency vector $y_t = [y_t^q, y_t^m, y_t^w]'$:

$$\begin{aligned} y_t &= \Lambda\alpha_t + \eta_t & \eta_t &\sim i.i.d.\mathrm{N}(0, R) \\ \alpha_t &= A_1\alpha_{t-1} + \cdots + A_p\alpha_{t-p} + u_t & u_t &\sim i.i.d.\mathrm{N}(0, Q) \end{aligned} \tag{2}$$

Modelling the serial correlation:

$$\begin{aligned} \eta_{it} &= \varepsilon_{it}^{(j)} + \xi_{it} & \xi_{it} &\sim i.i.d.\mathrm{N}(0, \kappa) \\ \varepsilon_{it}^{(j)} &= \boldsymbol{\psi}_i\varepsilon_{it-1}^{(j)} + e_{it} & e_{it} &\sim i.i.d.\mathrm{N}(0, \sigma_i^2) \end{aligned} \tag{3}$$

where $\xi_t = [\xi_{1t}, \xi_{2t}, \ldots, \xi_{n_jt}]'$ and the idiosyncratic residuals are cross sectionally uncorrelated and κ is a very small number. This restriction allow us to perform

a bias correction when deriving the closed form solution for the matrix Λ in the M-step. We can re-write the model with a new state space representation:

$$\begin{bmatrix} y_t^q \\ y_t^m \\ y_t^w \end{bmatrix} = \begin{bmatrix} \Lambda^q & I_{n_q} \otimes \gamma^q & 0 & 0 \\ \Lambda^m & 0 & I_{n_m} \otimes \gamma^m & 0 \\ \Lambda^w & 0 & 0 & I_{n_w} \end{bmatrix} \begin{bmatrix} \tilde{f}_t \\ \varepsilon_t^q \\ \varepsilon_t^m \\ \varepsilon_t^w \end{bmatrix} + \xi_t \qquad \xi_t \sim iid\ \mathrm{N}(0, \tilde{R})$$

$$\begin{bmatrix} \tilde{f}_t \\ \varepsilon_t^q \\ \varepsilon_t^m \\ \varepsilon_t^w \end{bmatrix} = \begin{bmatrix} \Phi & 0 & 0 & 0 \\ 0 & \Psi^q & 0 & 0 \\ 0 & 0 & \Psi^m & 0 \\ 0 & 0 & 0 & \Psi^w \end{bmatrix} \begin{bmatrix} \tilde{f}_{t-1} \\ \varepsilon_{t-1}^q \\ \varepsilon_{t-1}^m \\ \varepsilon_{t-1}^w \end{bmatrix} + v_t \qquad v_t \sim iid\ \mathrm{N}(0, \tilde{Q}) \tag{4}$$

where:

$$\begin{aligned}
\varepsilon_t^j &= [\varepsilon_{1t}^{(j)}, \ldots, \varepsilon_{1t-k_j}^{(j)}, \ldots, \varepsilon_{n_j t}^{(j)}, \ldots, \varepsilon_{n_j t-k_j}^{(j)}]' \\
\tilde{f}_t &= [f_t, f_{t-1}, \ldots, f_{t-k_q}]' \\
\alpha_t &= [\tilde{f}_t, \varepsilon_t^q, \varepsilon_t^m, \varepsilon_t^w]' \\
\Phi &= \begin{bmatrix} A_1 & \cdots & A_p & 0_r & \cdots & 0_r \\ & & I_{r \cdot k_q - 1} & & & \vdots \\ & & & & & 0_r \end{bmatrix}_{(r\,k_q)\cdot(r\,k_q)} \\
\Psi^j &= diag(\psi_1^{(j)}, \ldots, \psi_{n_j}^{(j)}) \quad \text{of dimension} \quad (n_j\,k_j)\cdot(n_j\,k_j) \\
&\quad \text{which diagonal elements } \psi_i^{(j)} \text{ are the companion matrices of an } AR(1) \\
\tilde{R} &= [diag(\kappa_1, \ldots, \kappa_N)] \\
\tilde{Q} &= \begin{bmatrix} \Sigma^f & 0 & 0 & 0 \\ 0 & \Sigma^q & 0 & 0 \\ 0 & 0 & \Sigma^m & 0 \\ 0 & 0 & 0 & \Sigma^w \end{bmatrix} \quad \text{which reflects the block structure of } A.
\end{aligned} \tag{5}$$

1.3 Estimation

Let $\boldsymbol{\Theta}$ collects all the parameters to be estimated:

$$\boldsymbol{\Theta} = \left[\Lambda^q, \Lambda^m, \Lambda^w, \Phi, \Psi^q, \Psi^m, \Psi^w, \Sigma^f, \Sigma^q, \Sigma^m, \Sigma^w\right] \tag{6}$$

1. Initialization State Space: we apply the Principal Component Analysis and OLS. To deal with the mixed-frequency, we perform an initial interpolation of low-frequency data via splines. Lastly, the power law aggregation scheme is imposed applying a Restricted Least Squares estimation.

2. E-Step: the expectation of the log-likelihood conditional on the data is obtained running the Kalman Filter and Smoother using the parameters obtained from the previous iteration $\boldsymbol{\Theta}(j-1)$:

$$\mathcal{L}(\boldsymbol{\Theta}, \boldsymbol{\Theta}_{(j)}) = \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}\Big[log(\mathcal{L}ik(Y, \alpha; \boldsymbol{\Theta}|\Omega_T))\Big] \tag{7}$$

   where the first iteration makes use of the initialized parameter matrices.

3. M-Step: the parameters are re-estimated through the maximisation of the expected log-likelihood with respect to $\boldsymbol{\Theta}$ using the smoothed states:

$$\boldsymbol{\Theta}_{(j+1)} = \arg\max_{\boldsymbol{\Theta}} \mathcal{L}(\boldsymbol{\Theta}, \boldsymbol{\Theta}_{(j)}) \tag{8}$$

The convergency is achieved when:

$$\frac{\mathcal{L}(\boldsymbol{\Theta}, \boldsymbol{\Theta}_{(j)}) - \mathcal{L}(\boldsymbol{\Theta}, \boldsymbol{\Theta}_{(j-1)})}{\Big(|\mathcal{L}(\boldsymbol{\Theta}, \boldsymbol{\Theta}_{(j)})| + |\mathcal{L}(\boldsymbol{\Theta}, \boldsymbol{\Theta}_{(j-1)})|\Big)} < 10e^{-5} \tag{9}$$

1.4 Forecasting with the Kalman Filter & Smoother Apparatus

Given the parameters $\hat{\boldsymbol{\Theta}}$ and the latest data vintage Ω_{v+1}, we can replace the missing observations with the conditional expectations:

$$\mathrm{E}[y_{t_j}|\Omega_{v+1}] = \Lambda\, \mathrm{E}_{\hat{\boldsymbol{\Theta}}}[\alpha_{t_j}|\Omega_{v+1}] \tag{10}$$

Depending on the different application, we use these conditional expectations to obtain:

1. Forecast: $\mathrm{E}[y^k_{T+h}|\Omega_{v+1}]$ with $h > 0$;

2. Nowcast: $\mathrm{E}[y^k_T|\Omega_{v+1}]$;

3. Backcast: $\mathrm{E}[y^k_{t_j}|\Omega_{v+1}]$ with $t_j < T$;

4. Interpolations: low frequency variables (quarterly and monthly) to high frequency.

Given two consecutive data vintages Ω_v and Ω_{v+1} and the target variable $y^k_{t_k}$ we have:

$$\Omega_v \subset \Omega_{v+1} \quad and \quad \Omega_{v+1} \setminus \Omega_v = \{y^j_{t_j},\ j = 1, ..., J\}$$

where J is the number of newly released data points. The Kalman Filter & Smoother apparatus lets us decompose the contribution of each released figure to the prediction of the variable of interest k in period t_k.

1. The vector of news $\mathcal{I}_{v+1} = [\mathcal{I}_{v+1,1} \ \dots \ \mathcal{I}_{v+1,J}]$ is defined as follows:

$$\mathcal{I}_{v+1,j} = y^j_{t_j} - \mathrm{E}[y^j_{t_j}|\Omega_v] \tag{11}$$

   which contains the orthogonal information to the previous data vintage.

2. Then, the revision (or impact) is obtained as the weighted average of the news in the latest data vintage:

$$\mathrm{E}[y^k_{t_k}|\mathcal{I}_{v+1}] = \sum_{j=1}^{J} \omega^j_{t_k} \left(y^j_{t_j} - \mathrm{E}[y^j_{t_j}|\Omega_v]\right) \tag{12}$$

   where the weights $\omega^j_{t_k}$ are available from the Kalman Filter & Smoother. Indeed, the expression for the revision could also be expanded as follows:

$$\mathrm{E}[y^k_{t_k}|\mathcal{I}_{v+1}] = \mathrm{E}[y^k_{t_k}\mathcal{I}'_{v+1}]\,\mathrm{E}[\mathcal{I}_{v+1}\mathcal{I}'_{v+1}]\,\mathcal{I}_{v+1} \tag{13}$$

   where the j^{th} element of $\mathrm{E}[y^k_{t_k}\,\mathcal{I}_{v+1}]$ and the $(j,l)^{th}$ element of $\mathrm{E}[\mathcal{I}_{v+1}\mathcal{I}'_{v+1}]$ are:

$$\begin{aligned} \mathrm{E}[y^k_{t_k}\,\mathcal{I}_{v+1,j}] &= \Lambda_k\,\mathrm{E}\Big[(\alpha_{t_k} - \mathrm{E}[\alpha_{t_k}|\Omega_v])(\alpha_{t_j} - \mathrm{E}[\alpha_{t_j}|\Omega_v])'\Big]\,\Lambda'_j \\ \mathrm{E}[\mathcal{I}_{v+1,j}\mathcal{I}'_{v+1,l}] &= \Lambda_j\,\mathrm{E}\Big[(\alpha_{t_j} - \mathrm{E}[\alpha_{t_j}|\Omega_v])(\alpha_{t_l} - \mathrm{E}[\alpha_{t_l}|\Omega_v])'\Big]\,\Lambda'_l + \tilde{R}_{jl} \end{aligned} \tag{14}$$

   In order to estimate the revision, we need the intertemporal variance matrix between α_{t_j} and α_{t_l}:

$$\mathrm{E}\Big[(\alpha_{t_j} - \mathrm{E}[\alpha_{t_j}|\Omega_v])(\alpha_{t_l} - \mathrm{E}[\alpha_{t_l}|\Omega_v])'\Big] \tag{15}$$

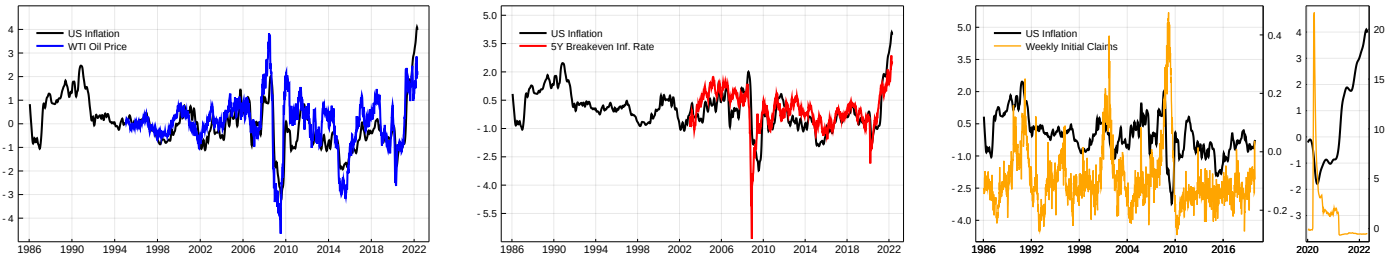
   Instead of augmenting the state space by the required lags, we apply the recursive estimation of ... (De Jong and Mackinnon)

3. Lastly, the new forecast is available as the sum of the old forecast and the revision:

$$\underbrace{\mathrm{E}[y^k_{t_k}|\Omega_{v+1}]}_{\text{new forecast}} = \underbrace{\mathrm{E}[y^k_{t_k}|\Omega_v]}_{\text{old forecast}} + \underbrace{\mathrm{E}[y^k_{t_k}|\mathcal{I}_{v+1}]}_{\text{revision}}. \tag{16}$$

The update of the forecast not only depends on the size of the news, but also to its relevance for the target series.

2 US Real-Time Evaluation



(a) Oil **(b)** Inflation Expectations **(c)** Weekly Initial Claims

Figure 3: Intro

2.1 COVID and Ukraine War Analysis

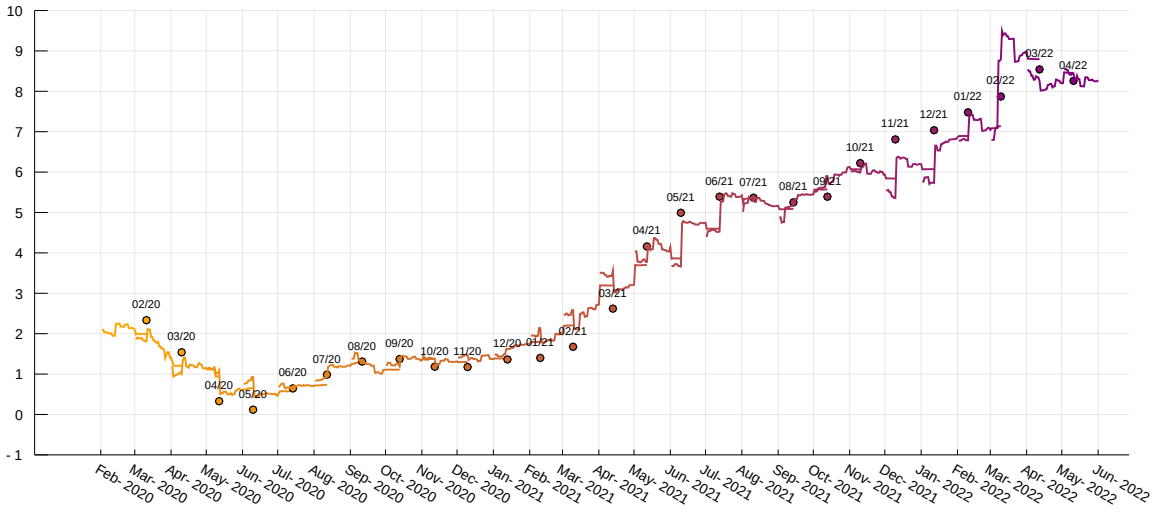
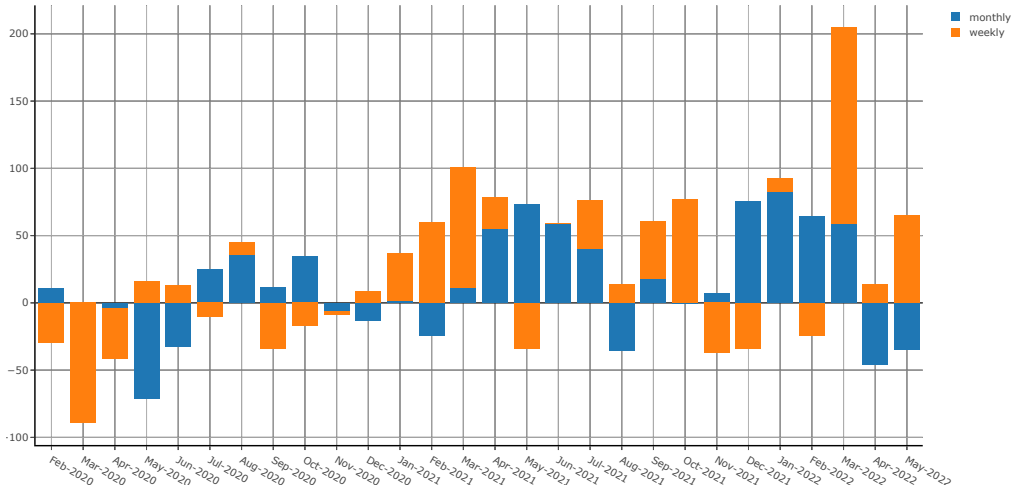
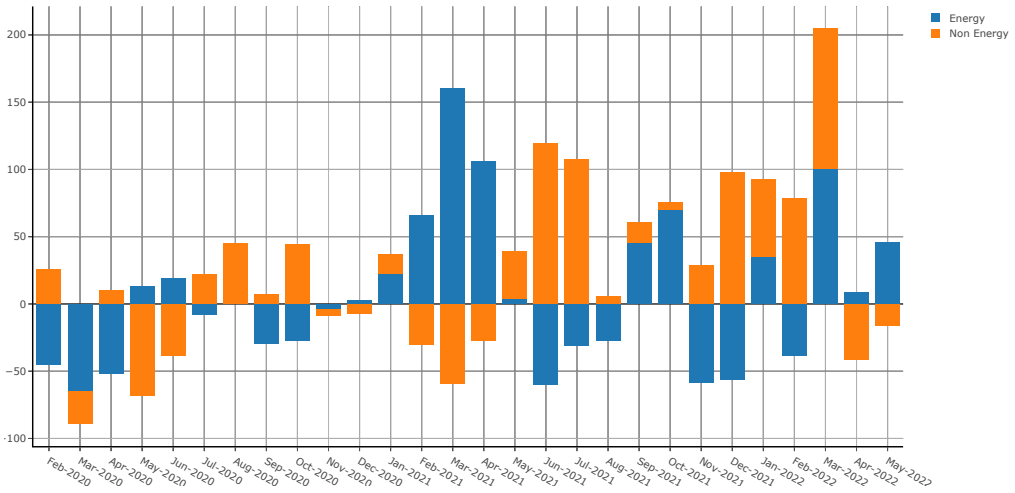


Figure 4: Predictions covid and war period.

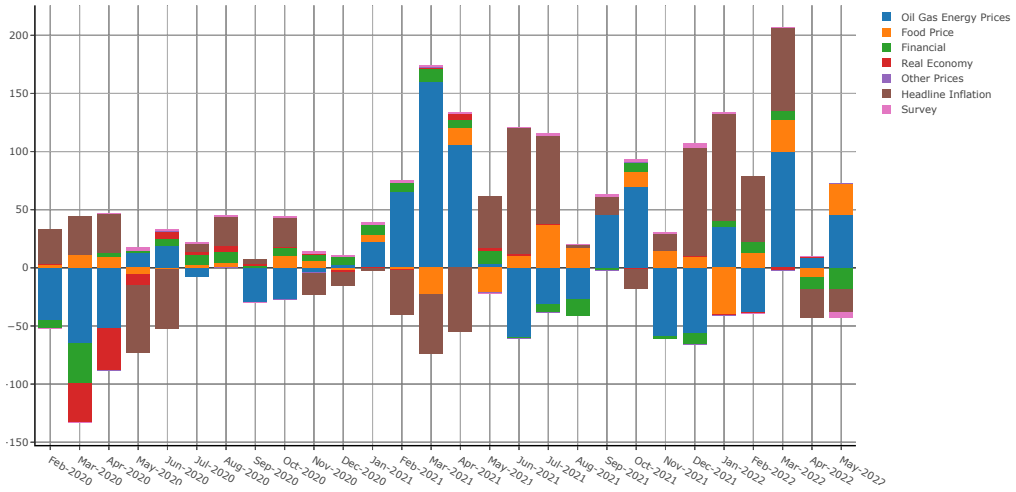


(a) Revision by frequency

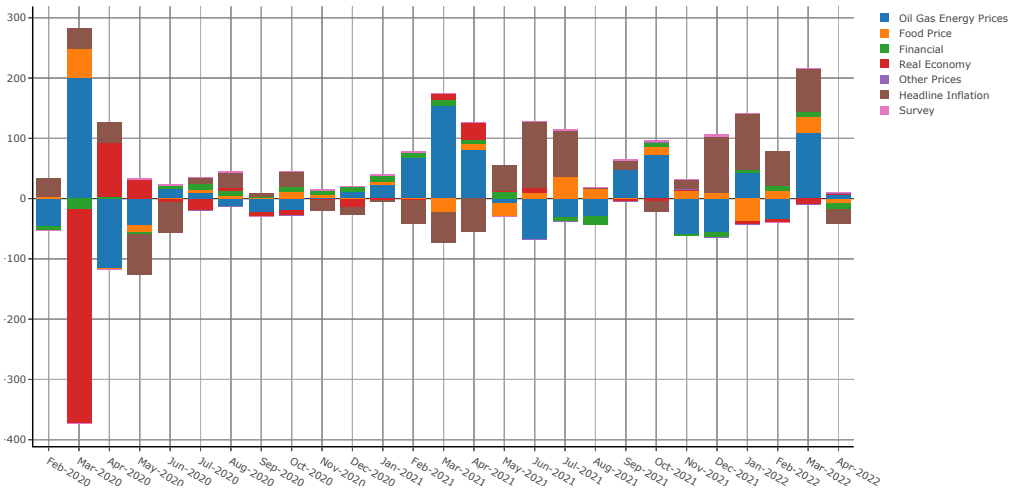


(b) Role of Energy related series

Figure 5: Role of weekly and energy-related series.



(a) Revision by sector



(b) Counterfactual

Figure 6: Revision by sectors and counterfactual.

2.2 Financial Crisis

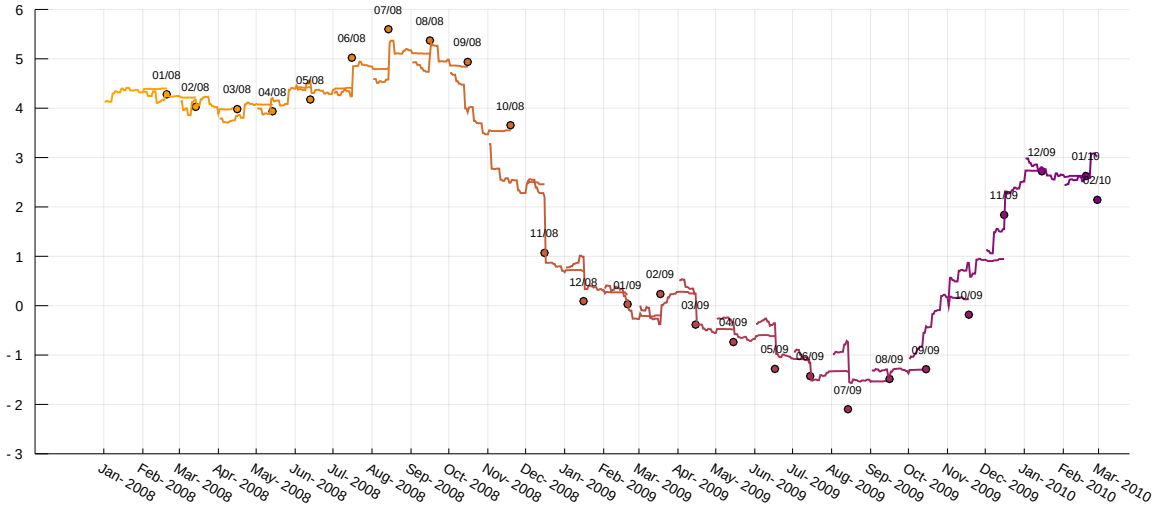
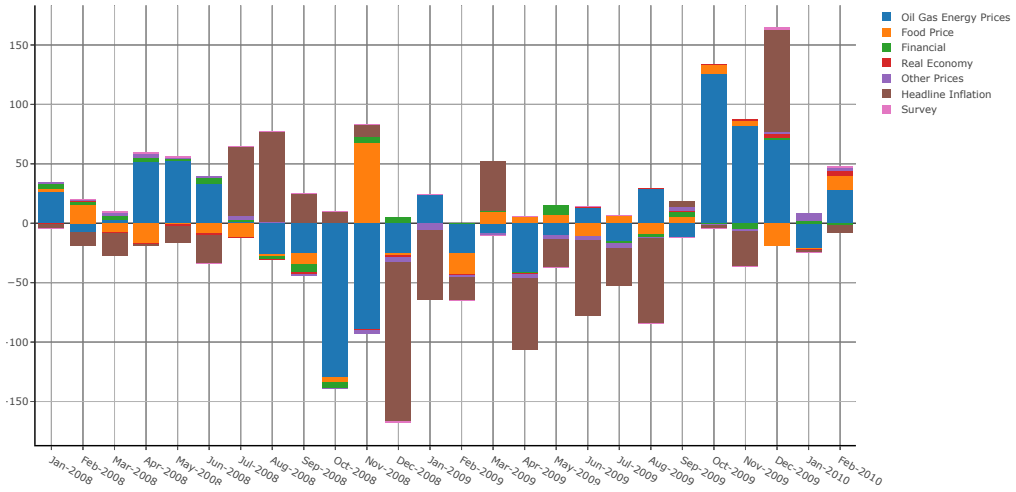
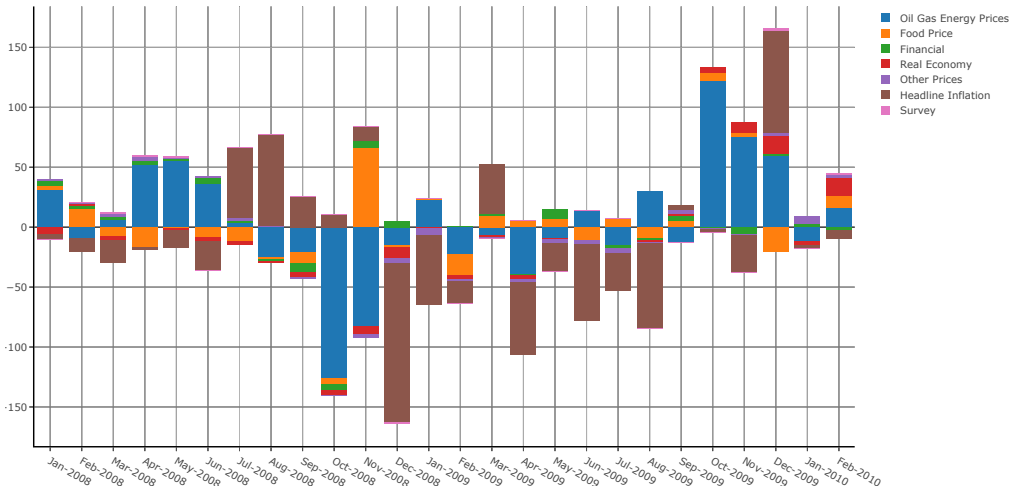


Figure 7: Predictions financial crisis



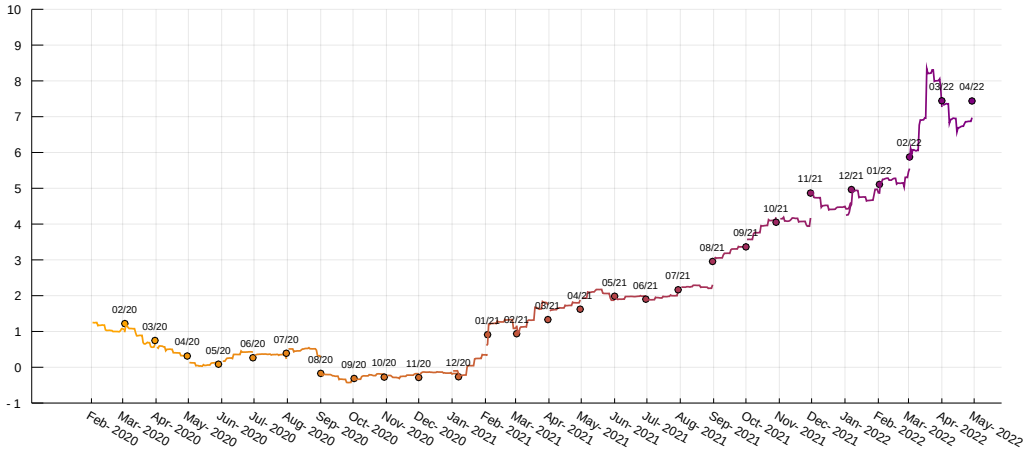
(a) Revision by sector



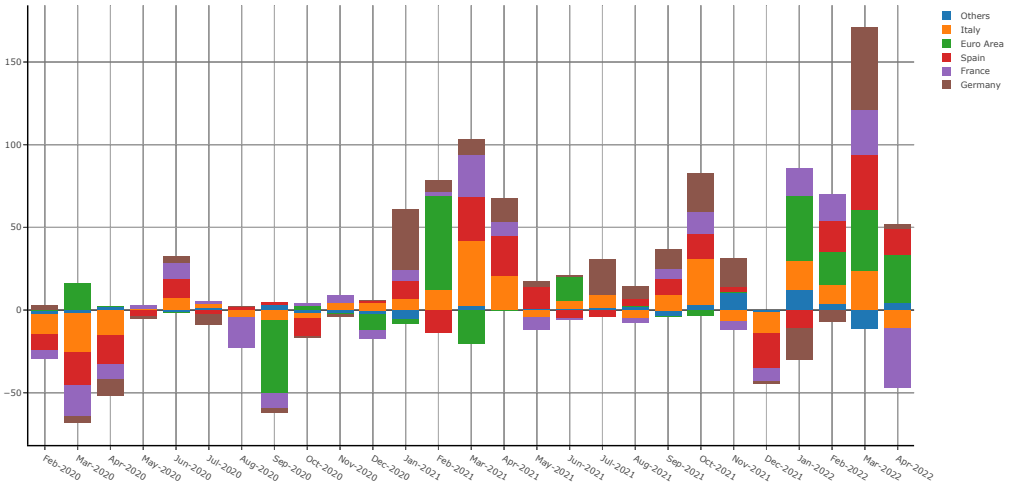
(b) Counterfactual

Figure 8: Revision by sectors and counterfactual.

3 Euro-Area during COVID and War

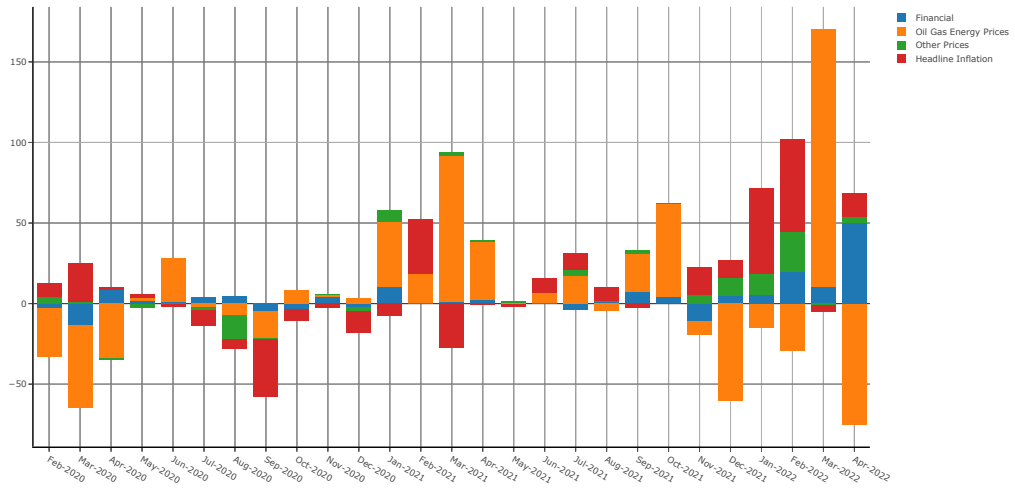


(a) Historical Reconstruction

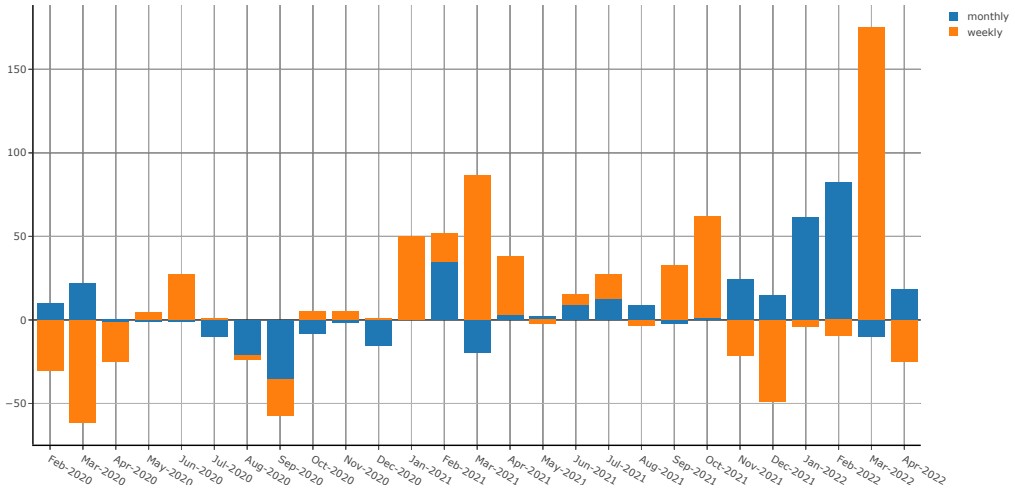


(b) Revision by country

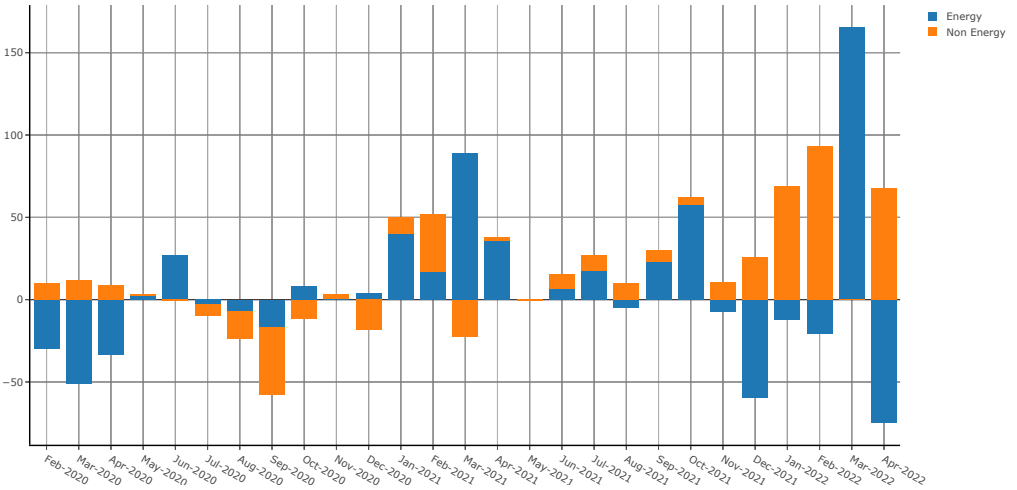
Figure 9: Case study: nowcasting inflation in times of COVID and war.



(a) Revision by sector



(b) Role of weekly series



(c) Role of Energy related series

Figure 10: Case study: nowcasting inflation in times of COVID and war, role of different sectors and weekly frequency.

4 Conclusion

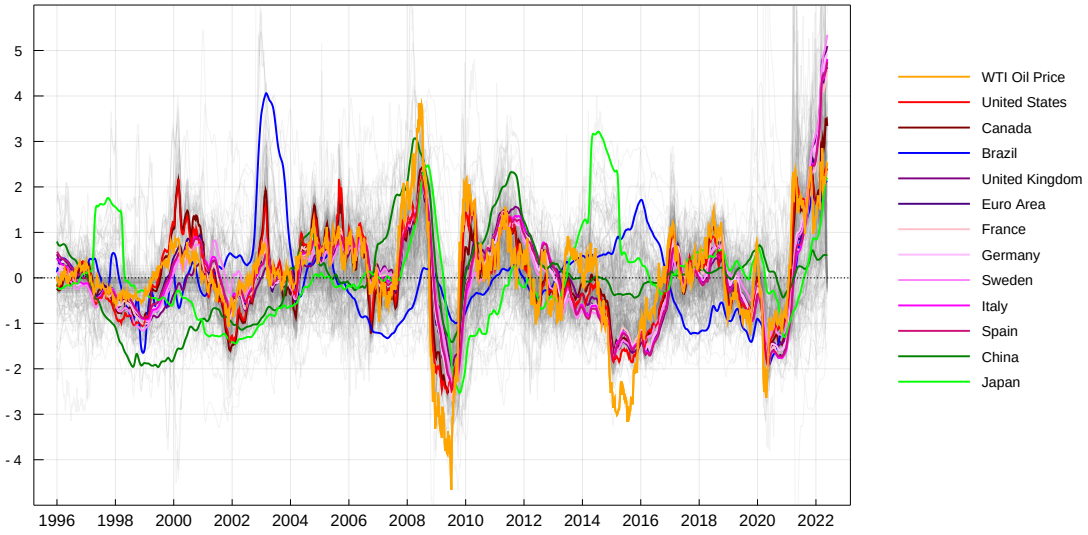


Figure 11: Factors of our 12 countries and weekly WTI

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References

Appendix A EM algorithm estimation

Given the state space representation of the model, the joint log-likelihood is given by (omitting constant terms):

$$log(\mathcal{L}ik(Y,\alpha;\mathbf{\Theta}|\Omega_T)) \simeq -\frac{T}{2}log\,|\tilde{Q}| - \frac{1}{2}tr\left[\tilde{Q}^{-1}\sum_{t=1}^{T}\Big(\alpha_t - A\alpha_{t-1}\Big)\Big(\alpha_t - A\alpha_{t-1}\Big)'\right] - \frac{T}{2}log\,|\tilde{R}| - \frac{1}{2}tr\left[\tilde{R}^{-1}\sum_{t=1}^{T}\Big(y_t - \Lambda\alpha_{t-1}\Big)\Big(y_t - \Lambda\alpha_{t-1}\Big)'\right] \tag{17}$$

With some initial estimates of the parameters $\mathbf{\Theta}(0)$ the EM algorithm would proceed as follows:

$$\text{E - step:} \qquad \mathcal{L}(\mathbf{\Theta},\mathbf{\Theta}_{(j)}) = \mathrm{E}_{\mathbf{\Theta}_{(j)}}\Big[log(\mathcal{L}ik(Y,\alpha;\mathbf{\Theta}|\Omega_T))\Big]$$

$$\text{M - step:} \qquad \mathbf{\Theta}_{(j+1)} = \arg\max_{\mathbf{\Theta}} \mathcal{L}(\mathbf{\Theta},\mathbf{\Theta}_{(j)})$$

The expectation of the log-likelihood conditional on the data is obtained from the Kalman Filter and Smoother. First, we run the forward recursion for $t = 0, ..., T$:

- Prediction of the state variable $\alpha_{t|t-1} = A\,\alpha_{t-1|t-1}$ and its conditional variance/covariance matrix $P_{t|t-1} = AP_{t|t-1}A' + \tilde{Q}$
- Compute the prediction error $v_t = y_t - \Lambda\,\alpha_{t|t-1}$ and its conditional variance/covariance matrix $F_{t|t-1} = \Lambda P_{t|t-1}\Lambda' + \tilde{R}$
- Compute the Kalman Gain $K_t = P_{t|t-1}\Lambda' F_{t|t-1}^{-1}$ and the value of log-likelihood at time t: $\mathcal{L}_t = 0.5|F_{t|t-1}^{-1}| - v_t' F_{t|t-1}^{-1} v_t$
- Update value of the state $\alpha_{t|t} = \alpha_{t|t-1} + K_t v_t$ and its conditional variance/covariance matrix $P_{t|t} = P_{t|t-1} - K_t\Lambda P_{t|t-1}$

Second, we proceed with the backward recursion $t = T, ..., 0$ - which allows us to refine estimates of previous states, in the light of later observations: $\alpha_{t|t+1}$ and $P_{t|t+1}$.

- We define $J_t \equiv P_{t|t}A'P_{t+1|t}$
- Compute smoothed state $\alpha_{t|t+1} = \alpha_{t|t} + J_t\Big(\alpha_{t+1|t+2} - \alpha_{t+1|t}\Big)$

The new parameter estimates in the M-step can be obtained in two steps. Let W_t be a diagonal matrix of size N with i^{th} diagonal element equal to zero if y_{it} is missing and equal to 1 otherwise, we use this selection matrix to apply the EM estimation

to the case with general pattern of missing data. Moreover, we implement the power law aggregation scheme imposing the restriction $\Gamma_\Lambda vec(\Lambda) = \gamma_\Lambda$. Then, $\Lambda(j+1)$ and $A(j+1)$ are given by:

$$vec(\Lambda^u(j+1)) = \left(\sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\alpha_t \alpha_t' | \Omega_v] \otimes W_t \right)^{-1} vec\left(W_t y_t \sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[y_t \alpha_t' | \Omega_v] \right) \quad (18)$$

$$\begin{aligned} vec(\Lambda(j+1)) = \; & vec(\Lambda^u(j+1)) + \left(\sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\alpha_t \alpha_t' | \Omega_v] \otimes \tilde{R}(J) \right) \Gamma_\Lambda' \times \\ & \times \left(\Gamma_\Lambda \left(\sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\alpha_t \alpha_t' | \Omega_v] \otimes \tilde{R}(j) \right) \Gamma_\Lambda' \right)^{-1} \left(\gamma_\Lambda - \Gamma_\Lambda vec(\Lambda^u(j+1)) \right) \end{aligned} \quad (19)$$

$$A(j+1) = \left(\sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\alpha_t \alpha_{t-1}' | \Omega_v] \right) \left(\sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\alpha_{t-1} \alpha_{t-1}' | \Omega_v] \right)^{-1} \quad (20)$$

Given the new estimates of Λ and A, the covariance matrix of the transition equation can be obtained as follows:

$$\tilde{Q}(j+1) = \frac{1}{T} \left(\sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\alpha_t \alpha_t' | \Omega_v] - A(j+1) \sum_{t=1}^{T_v} \mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\alpha_{t-1} \alpha_t' | \Omega_v] \right) \quad (21)$$

All the expectations $\mathrm{E}_{\boldsymbol{\Theta}_{(j)}}[\,\cdot\,|\Omega_v]$ in the formulae above are obtained via the Kalman Filter and Smoother. Given the state space of the model and block nature of Λ, A and $\tilde{Q}$, the parameters are estimated blockwise by frequency and distinguishing by factor $\tilde{f}_t$ and idiosyncratic residuals ε_t^j.

Appendix B Data

Table 2: US dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Import Price Index: All Imports (NSA, 2000=100)	1	1	1	13
CPI-U: Energy (SA, 1982-84=100)	1	1	1	15
CPI-U: Energy Services (SA, 1982-84=100)	1	1	1	15
PCE: Services: Chain Price Index (SA, 2012=100)	1	1	1	29
S&P GSCI Natural Gas Index (AVG, Dec-31-93=100)	1	1	1	1
S&P GSCI Crude Oil Index (AVG, Index)	1	1	1	1
S&P GSCI Brent Crude Index (AVG, Jun-06-99=100)	1	1	1	1
S&P GSCI Petroleum Index (AVG, Dec-31-82=100)	1	1	1	1
S&P GSCI 4-Month Forward Index (AVG, Jan-16-95=100)	1	1	1	1
Domestic Spot Market Price: Louisiana Sweet, St James Crude (/Barrel)	1	1	1	1
Light Sweet Crude Oil Futures Price: 2-Year Contract Settlement (EOP, /bbl)	1	1	1	1
Farmers' Prices Paid: Commodities, Svcs, Interest, Taxes, & Wage Rates(2011=100)	1	1	1	30
Wheat Futures Price: 2nd Expiring Contract Open (EOP, Cents/bu)	1	1	1	1
Rough Rice Futures Price: 1st Expiring Contract Open (Cents/bu)	1	1	1	1
Spot Oil Price: West Texas Intermediate [Prior'82=Posted Price] (/Barrel)	1	1	1	1
CPI-U: All Items (NSA, 1982-84=100)	1	1	1	15
CPI-U: All Items Less Food and Energy (NSA, 1982-84=100)	1	1	1	15
University of Michigan: Expected Inflation Rate, Next Year (%)	1	1	1	-17
Civilian Unemployment Rate: 16 yr + (SA, %)	0	1	1	5
CPI-U: Fuel Oil (NSA, 1982-84=100)	1	1	1	15
CPI-U: Motor Fuel (NSA, 1982-84=100)	1	1	1	15
CPI-U: Other Motor Fuels: Dec-97=100 (Y/Y %Chg)	0	0	0	15
CPI-U: Commodities Less Food: 1982-84=100 (Y/Y %Chg)	0	0	0	15
CPI-U: Transportation: 1982-84=100 (Y/Y %Chg)	0	0	0	15
Weekly				
Redbook Research: Same Store, Retail Sales Average (NSA, Y/Y %Chg)	0	0	0	3
Raw Steel Production (SA, Thous Net Tons)	1	1	1	2
Crude Oil Prices: West Texas Intermediate (WTI) - Cushing, Oklahoma, Change from Year Ago, Dollars per Barrel	0	0	0	4
US Regular All Formulations Gas Price, Dollars per Gallon	1	1	1	2
US Regular Conventional Gas Price, Dollars per Gallon	1	1	1	2
US Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
US Midgrade All Formulations Gas Price, Percent Change from Year Ago	0	0	0	2
Unemployment Insurance: Initial Claims, State Programs (SA, Thous)	1	1	1	5
PADD V (West Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
PADD I (East Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
Crude Oil Prices: Brent - Europe, Change from Year Ago, Dollars per Barrel	0	0	0	4
5-Year Breakeven Inflation Rate (NSA)	0	0	0	0
Cash Price: Wheat, Spring, 14% Protein: Minneapolis (Avg, /Bushel)	1	1	1	-1
Cash Price: Oats, 2 Milling: Minneapolis (Avg, /Bu)	1	1	1	-1
Cash Price: Flour, Hard Winter: Kansas City (Avg, /cwt)	1	1	1	-1

Table 3: Canada dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Canada: Consumer Price Index (NSA, 2002=100)	1	1	1	20
Canada: CPI: Shelter (NSA, 2002=100)	1	1	1	20
S&P GSCI GasOil Index (AVG, Index)	1	1	1	0
S&P GSCI Unleaded Gasoline Total Excess Return Index (AVG, Dec-31-87=100)	1	1	1	0
S&P GSCI GasOil Total Excess Return Index (AVG, Index)	1	1	1	0
EA 19: HICP Monetary Union Index of Consumer Prices (NSA, 2015=100)	1	1	1	1
CPI-U: All Items (NSA, 1982-84=100)	1	1	1	15
CPI-U: Energy (NSA, 1982-84=100)	1	1	1	15
CPI-U: Fuel Oil (NSA, 1982-84=100)	1	1	1	15
Canada: CPI: All Items excluding Food and Energy (NSA, 2002=100)	1	1	1	20
Canada: CPI: Transportation (NSA, 2002=100)	1	1	1	20
Canada: Ivey Purchasing Managers Prices Index (NSA, 50+ = Econ Expand)	1	1	1	3
Canada: Chain Fisher BoC Commodity Price Index: Energy (NSA, Jan-72=100)	1	1	1	2
Canada: Furnace Oil Retail Price (EOP, CAD Cents/liter)	1	1	1	0
Canada: Diesel Retail Price (EOP, CAD Cents/liter)	1	1	1	0
Canada: Mid-grade Gasoline Retail Price (EOP, CAD Cents/liter)	1	1	1	0
Weekly				
US Regular All Formulations Gas Price, Dollars per Gallon	1	1	1	2
US Regular Conventional Gas Price, Dollars per Gallon	1	1	1	2
US Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
US Midgrade All Formulations Gas Price, Percent Change from Year Ago	0	0	0	2
PADD V (West Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
PADD I (East Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
Canadian Dollar 1-Yr Deposit Rate (%)	0	1	1	2
Canada: Commodity Price Index: Energy (Jan-72=100)	1	1	1	-2
Canada: Commodity Price Index: Agriculture (Jan-72=100)	1	1	1	-2
Canada: Commodity Price Index (Jan-72=100)	1	1	1	-2
Canada: Canola Nearby Contract: Settlement Price (C/Metric Ton)	1	1	1	2
Canada: Volume Weighted Average Regular Gasoline Price (EOP, CAD Cents/liter)	1	1	1	3
Canada: Volume Weighted Average Diesel Retail Price (EOP, CAD Cents/liter)	1	1	1	3
Canada: Volume Weighted Average Furnace Oil Price (EOP, CAD Cents/liter)	1	1	1	3
Canadian Dollar 5-Yr Interest Rate Swap (%)	0	1	1	0
Canada: Kent Grp Ltd Selected Crude Oil Prices: Western Canada Select(AVG,C/M3)	0	0	0	2
Canada: Montreal Furnace Oil Retail Price (EOP, CAD Cents/liter)	1	1	1	3
Canada: Quebec Furnace Oil Retail Price (EOP, CAD Cents/liter)	1	1	1	3
Canada: Quebec Diesel Retail Price (EOP, CAD Cents/liter)	1	1	1	3
Canada: Montreal Diesel Retail Price (EOP, CAD Cents/liter)	1	1	1	3
Canada: Commodity Price Index: Metals and Minerals (Jan-72=100)	1	1	1	-2
Canada: 12 Month Overnight Index Swap vs CORRA: Mid Rate (AVG, % p.a.)	0	1	1	-1
Canada: Effective Business Interest Rate (%, EOP)	0	1	1	2

Table 4: Brazil dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Brazil: Natl Consumer Price Index [Extended,IPCA] (NSA, 12/93=100)	1	1	1	8
Brazil: IPCA: Food & Beverages (NSA, 2015=100)	1	1	1	8
Brazil: IPCA: Bakery (NSA, 2015=100)	1	1	1	8
Brazil: IPCA: Dwellings (NSA, 2015=100)	1	1	1	8
Brazil: IPCA: Textiles (NSA, 2015=100)	1	1	1	8
Brazil: IPCA: Transport (NSA, 2015=100)	1	1	1	8
Brazil: IPCA: Personal Care Products (NSA, 2015=100)	1	1	1	8
Brazil: IPCA: Personal Care Services (NSA, 2015=100)	1	1	1	8
Brazil: PPI: Manufacture of Apparel and Accessories (NSA, Dec-18=100)	1	1	1	30
Brazil: IPCA: Expected Inflation Over the Next 12 Months (NSA,%)	0	0	0	24
Brazil: ANP Fuel Price & Margin Report: Ethanol: Avg Retail Price(Reais/Liter)	1	1	1	10
Brazil: ANP Fuel Price & Margin Report: Gasoline: Avg Retail Price(Reais/Liter)	1	1	1	10
Brazil: Real Average Monthly Earnings of All Jobs: 3-Mo Moving Average (EOP, R)	1	1	1	30
Brazil: Consumer Inflation Expectations for Next 12 Months (NSA, %)	0	0	0	-6
Brazil: FOCUS Survey: IPCA: Inflation Forecast Next 12 Months: Med (AVG,%)	0	0	0	2
Weekly				
Brazil: Basic Financing Rate (AVG, % per Month)	0	1	1	3
Brazil: 1 Year Implied Cash Deposit Mid Rate (AVG, % p.a.)	0	1	1	0
Brazil: 2 Year Treasury Bond Mid Yield (AVG, % p.a.)	0	1	1	0
Brazil: 1 Year Government Bond Yield(EOP, %)	0	1	1	3
Brazil: ANP Fuel Pr/Mg Report: Unl Diesel: Avg Retail Price(Reais/Liter)	1	1	1	3
Brazil: ANP Fuel Pr/Margin Report: Gasoline: Avg Retail Price(Reais/Liter)	1	1	1	3
Brazil: FOCUS Survey: IPCA: Inflation Forecast Next 12Mnths:Med(EOP,%)	0	0	0	3
Brazil: Basic Financing Rate (AVG, % Daily)	0	1	1	3
Brazil: FOCUS Survey: IPCA: Infl Fcast Next 12 Mths: 30 Days Prior Med (AVG,%)	0	0	0	3
Brazil: FOCUS Survey: IPCA: Infl Fcast Next 12 Mths: 4 Days Prior (AVG,%)	0	0	0	3
Brazil: ANP Fuel Pr/Mg Report: Unl Diesel [S10]:Avg Retail Pr(Reais/Liter)	1	1	1	3

Table 5: UK dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
U.K.: Harmonized Index of Consumer Prices [HICP] (NSA, 2015=100)	1	1	1	16
UK: CPIH: All Items ex Energy, Food, Alcoholic Beverages/Tobacco(NSA, 2015=100)	1	1	1	16
UK: CPIH: Food & Non-Alcoholic Beverages (NSA, 2015=100)	1	1	1	16
UK: CPIH: Furniture, Household Equipment & Routine Maintenance (NSA, 2015=100)	1	1	1	16
Germany: Consumer Price Index (NSA, 2015=100)	1	1	1	-1
France: Consumer Price Index (NSA, 2015=100)	1	1	1	0
Italy: Consumer Price Index (NSA, 2015=100)	1	1	1	0
U.S.: Consumer Price Index (NSA, 1982-84=100)	1	1	1	15
Austria: Consumer Price Index (NSA, 2020=100)	1	1	1	1
Underlying Inflation Gauge: Prices-Only Measure (Yr/Yr % Change)	1	1	1	16
Mont Belvieu TX Propane Spot Price FOB (Avg Cents/Gallon)	1	1	1	1
EA 19: PPI: Capital Goods (NSA, 2015=100)	1	1	1	32
EA 19: HICP: Housing, Water, Electricity, Gas, Other Fuels(NSA, 2015=100)	1	1	1	10
S&P GSCI GasOil Index (AVG, Index)	1	1	1	0
Italy: CPI: Transport (NSA, 2015=100)	1	1	1	11
France: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	12
UK: Government Securities: Nominal Forward Yields, 12-Month (AVG, %)	0	1	1	1
UK: FTSE Actuaries Gilts: Index-Linked: Price Index: Up to 5 Years (EOP)	1	1	1	1
UK: Halifax House Prices: RPI (SA, 1992.Jan=100)	1	1	1	8
UK: FTSE Actuaries Gilts: Index-Linked:Total Return: Up to 5 Years (EOP)	1	1	1	1
UK: CBI Industrial Trends: Avg Prices of Domestic Orders Over Next 3 Mos(% Bal)	0	0	0	-10
UK: GfK Consumer Survey: Consumer Prices: Last 12 Months (NSA, % Bal)	0	0	0	-10
Weekly				
United Kingdom: Pump Price: Ultra Low Sulfur Unleaded Petrol (Pence/Liter)	1	1	1	3
United Kingdom: Pump Price: Ultra Low Sulfur Diesel (Pence/Liter)	1	1	1	3
ICE UK Natural Gas Futures: 1st Position: Settlement Price (AVG, Sterling/Therm)	1	1	1	2
U.K.: LME Aluminum, 99.7% Purity: Closing Cash Price (/Metric Tonne)	0	0	0	1
U.K. Pounds 1-Yr Deposit Rate (Avg, %)	0	1	1	1
U.K.: Inflation-Indexed Govt Secs Up to 5 yrs: Closing Price(DEC-31-86=100)	1	1	1	3
United Kingdom: 2 Year Treasury Bond Mid Yield (AVG, % p.a.)	0	1	1	-1
UK: Overnight Index Swap: Forward Yields, 6-Month (AVG, % p.a.)	0	1	1	2
Germany: 5 Year Breakeven Inflation Rate (AVG, % p.a.)	0	0	0	-1
Germany: 10 Year Breakeven Inflation Rate (AVG, % p.a.)	0	0	0	-1

Table 6: Euro-Area dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
EA 11-19: HICP Monetary Union: Index of Consumer Prices (NSA, 2015=100)	1	1	1	1
EA 19: HICP: Transport (NSA, 2015=100)	1	1	1	10
EA 19: HICP: Housing, Water, Electricity, Gas, Other Fuels(NSA, 2015=100)	1	1	1	10
EA 19: Domestic PPI: Industry excluding Construction (SA, 2015=100)	1	1	1	10
Germany: Consumer Price Index (NSA, 2015=100)	1	1	1	-1
Germany: CPI: Rent, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	10
Germany: CPI: Transportation (NSA, 2015=100)	1	1	1	10
Germany: PPI: Total Industry excluding Energy (NSA, 2015=100)	1	1	1	20
Germany: PPI: Consumer Goods (NSA, 2015=100)	1	1	1	20
Germany: Harmonized Index of Consumer Prices [HICP] (NSA, 2015=100)	1	1	1	-1
Italy: Consumer Price Index (NSA, 2015=100)	1	1	1	0
Italy: CPI: Housing, Water, Electricity and Gas (NSA, 2015=100)	1	1	1	5
Italy: CPI: Transport (NSA, 2015=100)	1	1	1	5
Italy: CPI Ex Food and Energy (NSA, 2015=100)	1	1	1	5
Italy: Domestic PPI: Consumer Goods (NSA, 2015=100)	1	1	1	36
Italy: Domestic PPI: Investment Goods (NSA, 2015=100)	1	1	1	36
Italy: Harmonized Index of Consumer Prices [HICP] (NSA, 2015=100)	1	1	1	-1
Italy: CPI excluding Tobacco Products (NSA, 2015=100)	1	1	1	-1
France: Consumer Price Index (NSA, 2015=100)	1	1	1	8
France: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	12
France: CPI: Transport (NSA, 2015=100)	1	1	1	12
France: Domestic Producer Price Index: Industry excl Construction(NSA, 2015=100)	1	1	1	21
France: Domestic PPI: Manufactured Products (NSA, 2015=100)	1	1	1	21
France: Harmonized Index of Consumer Prices (NSA, 2015=100)	1	1	1	7
Spain: Consumer Price Index (NSA, 2021=100)	1	1	1	-2
Spain: CPI excluding Nonprocessed Foods & Energy Products (NSA, 2021=100)	1	1	1	10
Spain: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2021=100)	1	1	1	10
Spain: CPI: Transportation (NSA, 2021=100)	1	1	1	10
Spain: Industrial Prices: Consumer Goods (NSA, 2015=100)	1	1	1	20
Spain: Harmonized Index of Consumer Prices [HICP] (NSA, 2015=100)	1	1	1	-2
Belgium: Consumer Price Index (NSA, 2013=100)	1	1	1	-2
S&P GSCI GasOil Index (AVG, Index)	1	1	1	0
S&P GSCI Euro Index (AVG, Mar-27-07=100)	1	1	1	0
US Import Price Index: All Imports (NSA, 2000=100)	1	1	1	15
US CPI-U: Energy (SA, 1982-84=100)	1	1	1	15
Weekly				
Germany: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Germany: LPG Motor Fuel w/ Tax (EUR/1000L)	1	1	1	5
Italy: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Italy: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
France: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
France: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Spain: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Spain: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Eurocurrency Market Rates: 12 Month Euro-Deposits (AVG, % p.a.)	0	1	1	17
Euro 5-Year Interest Rate Short Swap vs 6-Month Euribor (%)	0	1	1	1
Euro Area: 5 Yr Int Rate Swap [30/360 Ann] vs 6 Mth EURIBOR: Mid Rate(AVG,%)	0	1	1	-1
Euro Area 19:Heating Gas Oil Consumer Price inc Duties & Taxes(EUR/1000L)	1	1	1	5
Euro Area 19:Auto Gas Oil[Diesel]Pump Price inc Duties & Taxes(EUR/1000L)	1	1	1	5
Euro Area 19: Euro-super 95 Pump Price incl Duties & Taxes(EUR/1000L)	1	1	1	5
Germany: Yields on Total Debt Securities: 3 to 4 Years (% p.a.)	0	1	1	2
United Kingdom: Pump Price: Ultra Low Sulfur Diesel (Pence/Liter)	0	0	0	3
Germany: 5 Year Breakeven Inflation Rate (AVG, % p.a.)	0	0	0	-1
Germany: 10 Year Breakeven Inflation Rate (AVG, % p.a.)	0	0	0	-1

Table 7: France dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
France: Consumer Price Index (NSA, 2015=100)	1	1	1	8
France: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	12
France: CPI: Transport (NSA, 2015=100)	1	1	1	12
France: Domestic Producer Price Index: Industry excl Construction(NSA, 2015=100)	1	1	1	25
France: Domestic PPI: Manufactured Products (NSA, 2015=100)	1	1	1	25
Belgium: Consumer Price Index (NSA, 2013=100)	1	1	1	-2
EA 11-19: HICP Monetary Union: Index of Consumer Prices (NSA, 2015=100)	1	1	1	1
Italy: Consumer Price Index (NSA, 2015=100)	1	1	1	0
Spain: Consumer Price Index (NSA, 2021=100)	1	1	1	-2
Weekly				
PADD V (West Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
Crude Oil Prices: Brent - Europe, Change from Year Ago, Dollars per Barrel	0	0	0	4
France: Euro-super 95 Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
France: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
France: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
France: LPG Motor Fuel w/ Tax (EUR/1000L)	1	1	1	5

Table 8: Spain dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Spain: Consumer Price Index (NSA, 2021=100)	1	1	1	-2
Spain: CPI excluding Nonprocessed Foods & Energy Products (NSA, 2021=100)	1	1	1	10
Spain: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2021=100)	1	1	1	10
Spain: CPI: Transportation (NSA, 2021=100)	1	1	1	10
Spain: Industrial Prices: Consumer Goods (NSA, 2015=100)	1	1	1	20
Belgium: Consumer Price Index (NSA, 2013=100)	1	1	1	-2
EA 11-19: HICP Monetary Union: Index of Consumer Prices (NSA, 2015=100)	1	1	1	1
France: Consumer Price Index (NSA, 2015=100)	1	1	1	8
Italy: Consumer Price Index (NSA, 2015=100)	1	1	1	0
Italy: CPI: Housing, Water, Electricity and Gas (NSA, 2015=100)	1	1	1	5
Italy: CPI: Transport (NSA, 2015=100)	1	1	1	5
Italy: CPI Ex Food and Energy (NSA, 2015=100)	1	1	1	5
Italy: Domestic PPI: Consumer Goods (NSA, 2015=100)	1	1	1	36
Italy: Domestic PPI: Investment Goods (NSA, 2015=100)	1	1	1	36
France: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	12
France: CPI: Transport (NSA, 2015=100)	1	1	1	12
France: Domestic Producer Price Index: Industry excl Construction(NSA, 2015=100)	1	1	1	25
France: Domestic PPI: Manufactured Products (NSA, 2015=100)	1	1	1	25
Weekly				
PADD V (West Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
Crude Oil Prices: Brent - Europe, Change from Year Ago, Dollars per Barrel	0	0	0	4
Spain: Euro-super 95 Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Spain: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Spain: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Spain: Fuel Oil w/ Tax: Sulphur <=1% (EUR/Tons)	1	1	1	5
Spain: LPG Motor Fuel w/ Tax (EUR/1000L)	1	1	1	5

Table 9: Germany dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Germany: Consumer Price Index (NSA, 2015=100)	1	1	1	-1
Germany: CPI: Rent, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	10
Germany: CPI: Transportation (NSA, 2015=100)	1	1	1	10
Germany: PPI: Total Industry excluding Energy (NSA, 2015=100)	1	1	1	20
Germany: PPI: Consumer Goods (NSA, 2015=100)	1	1	1	20
Germany: GfK Consumer Survey, Economic Expectations (NSA, % Balance)	0	0	0	-4
Belgium: Consumer Price Index (NSA, 2013=100)	1	1	1	-2
EA 11-19: HICP Monetary Union: Index of Consumer Prices (NSA, 2015=100)	1	1	1	1
France: Consumer Price Index (NSA, 2015=100)	1	1	1	7
U.S.: Consumer Price Index (NSA, 1982-84=100)	1	1	1	15
Italy: Consumer Price Index (NSA, 2015=100)	1	1	1	0
Spain: Consumer Price Index (NSA, 2021=100)	1	1	1	-2
Italy: CPI: Housing, Water, Electricity and Gas (NSA, 2015=100)	1	1	1	5
Italy: CPI: Transport (NSA, 2015=100)	1	1	1	5
Italy: CPI Ex Food and Energy (NSA, 2015=100)	1	1	1	5
Italy: Domestic PPI: Consumer Goods (NSA, 2015=100)	1	1	1	36
Italy: Domestic PPI: Investment Goods (NSA, 2015=100)	1	1	1	36
France: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	12
France: CPI: Transport (NSA, 2015=100)	1	1	1	12
France: Domestic Producer Price Index: Industry excl Construction(NSA, 2015=100)	1	1	1	25
France: Domestic PPI: Manufactured Products (NSA, 2015=100)	1	1	1	25
Germany: Consumer: Price Trends over last 12 Months, Percent Balance (SA, %)	0	0	0	-1
Germany: Consumer: Price Trends over next 12 Months, Percent Balance (SA, %)	0	0	0	-1
Germany: Price Trends Last 12 Mo: Income 4th Quartile, Balance (SA, %)	0	0	0	-1
Weekly				
PADD V (West Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
Germany: Euro-super 95 Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Germany: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Germany: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Germany: LPG Motor Fuel w/ Tax (EUR/1000L)	1	1	1	5
Italy: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Italy: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
France: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Euro Area 19:Heating Gas Oil Consumer Price inc Duties & Taxes(EUR/1000L)	1	1	1	5
Euro Area 19:Auto Gas Oil[Diesel]Pump Price inc Duties & Taxes(EUR/1000L)	1	1	1	5
Germany: 5 Year Breakeven Inflation Rate (AVG, % p.a.)	1	1	1	-1
Germany: 10 Year Breakeven Inflation Rate (AVG, % p.a.)	1	1	1	-1

Table 10: Italy dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Italy: Consumer Price Index (NSA, 2015=100)	1	1	1	0
Italy: CPI: Housing, Water, Electricity and Gas (NSA, 2015=100)	1	1	1	5
Italy: CPI: Transport (NSA, 2015=100)	1	1	1	5
Italy: CPI Ex Food and Energy (NSA, 2015=100)	1	1	1	5
Italy: Domestic PPI: Consumer Goods (NSA, 2015=100)	1	1	1	36
Italy: Domestic PPI: Investment Goods (NSA, 2015=100)	1	1	1	36
EA 11-19: HICP Monetary Union: Index of Consumer Prices (NSA, 2015=100)	1	1	1	1
France: Consumer Price Index (NSA, 2015=100)	1	1	1	8
Belgium: Consumer Price Index (NSA, 2013=100)	1	1	1	-2
Spain: Consumer Price Index (NSA, 2021=100)	1	1	1	-2
France: CPI: Housing, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	12
France: CPI: Transport (NSA, 2015=100)	1	1	1	12
France: Domestic Producer Price Index: Industry excl Construction(NSA, 2015=100)	1	1	1	25
France: Domestic PPI: Manufactured Products (NSA, 2015=100)	1	1	1	25
Germany: CPI: Rent, Water, Electricity, Gas and Other Fuels (NSA, 2015=100)	1	1	1	10
Germany: CPI: Transportation (NSA, 2015=100)	1	1	1	10
Germany: PPI: Total Industry excluding Energy (NSA, 2015=100)	1	1	1	20
Germany: PPI: Consumer Goods (NSA, 2015=100)	1	1	1	20
Weekly				
PADD V (West Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2
Italy: Euro-super 95 Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Italy: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Italy: Heating Gas Oil Consumer Price including Duties & Taxes (EUR/1000L)	1	1	1	5
Italy: Fuel Oil w/ Tax: Sulphur <=1% (EUR/Tons)	1	1	1	5
Italy: LPG Motor Fuel w/ Tax (EUR/1000L)	1	1	1	5

Table 11: Sweden dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Sweden: Consumer Price Index (NSA, 1980=100)	1	1	1	13
Sweden: CPI: Housing (NSA, 1980=100)	1	1	1	13
Sweden: CPI: Transport (NSA, 1980=100)	1	1	1	13
Sweden: Harmonized Total PPI: Industry excluding Construction (NSA, 2015=100)	1	1	1	29
Sweden: Import Price Index: Total Agriculture/Industry excl Constr(NSA,2020=100)	1	1	1	25
France: Consumer Price Index (NSA, 2015=100)	1	1	1	8
EA 11-19: HICP Monetary Union: Index of Consumer Prices (NSA, 2015=100)	1	1	1	1
UK: CPIH: All Items (NSA, 2015=100)	1	1	1	16
Canada: Consumer Price Index (NSA, 2002=100)	1	1	1	20
Sweden: Construction Confidence Indicator, Percent Balance (SA, %)	0	0	0	0
Belgium: Consumer Price Index (SA, 2013=100)	1	1	1	-2
Finland: Consumer Price Index (SA, 2015=100)	1	1	1	13
U.S.: Consumer Price Index (SA, 1982-84=100)	1	1	1	15
Weekly				
Sweden: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (SEK/1000L)	1	1	1	5
Sweden: Yields on Mortgage Bonds: 2-Year (% per annum, EOP)	0	1	1	5
Germany: Auto Gas Oil [Diesel] Pump Price including Duties & Taxes (EUR/1000L)	1	1	1	5
PADD V (West Coast District) Diesel Sales Price, Percent Change from Year Ago	0	0	0	2

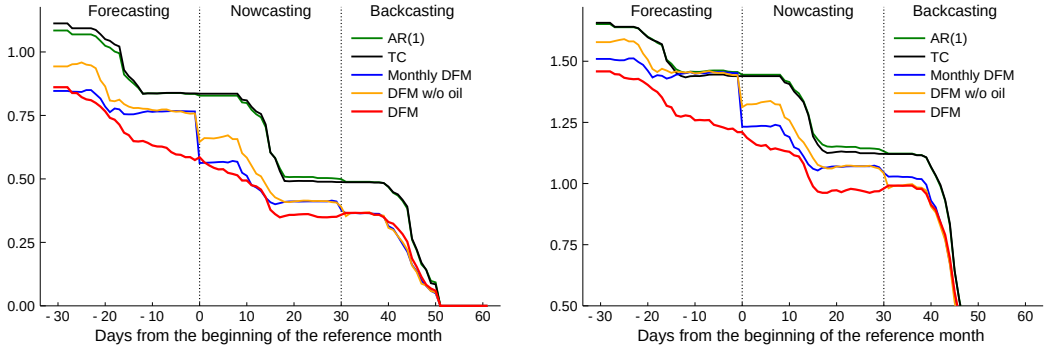
Table 12: China dataset

Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
China: Consumer Price Index (NSA, 2020=100)	1	1	1	10
China: CPI: Food (NSA, 2020=100)	1	1	1	10
China: CPI: Housing (NSA, 2020=100)	1	1	1	10
China: CPI: Housing: Water, Electricity and Fuel (NSA, 2020=100)	1	1	1	10
China: General Retail Price Index (NSA, 2020=100)	1	1	1	13
China: Retail Prices: Bldg Material, Hardware etc (NSA, 2020=100)	1	1	1	13
China: PPI: Consumer Goods (NSA, 2020=100)	1	1	1	10
China: PPI: Food (NSA, 2020=100)	1	1	1	10
China: PPI: Daily-use Articles (NSA, 2020=100)	1	1	1	10
Belgium: Consumer Price Index (NSA, 2013=100)	1	1	1	-2
Weekly				
China: Domestic Spot Wholesale Agricultural Prices: Fresh Pork(RMB/Kg)	1	1	1	4
China: Domestic Spot Wholesale Agricultural Prices: Carps(RMB/Kg)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Flour in Small Packet(RMB/Kg)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Soybean Oil(RMB/Liter)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Canola Oil(RMB/Liter)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Rice in Small Packet(RMB/Kg)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Salad Oil(RMB/Liter)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Grocery Chicken(RMB/Kg)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Eggs(RMB/Kg)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Milk (RMB/Liter)	1	1	1	4
China: Domestic Spot Retail Agricultural Prices: Yogurt(RMB/Kg)	1	1	1	4
CN: Max Supply Price aftr Adj: Gas, No 89 [II] for Militry & Othr Depts(RMB/Ton)	1	1	1	-1
CN: Max Supply Price after Adj: Diesel, No 0 for Military & Other Depts(RMB/Ton)	1	1	1	-1
China: 1-Month Shanghai Interbank Offered Rate [SHIBOR] (%)	0	1	1	-1

Table 13: Japan dataset

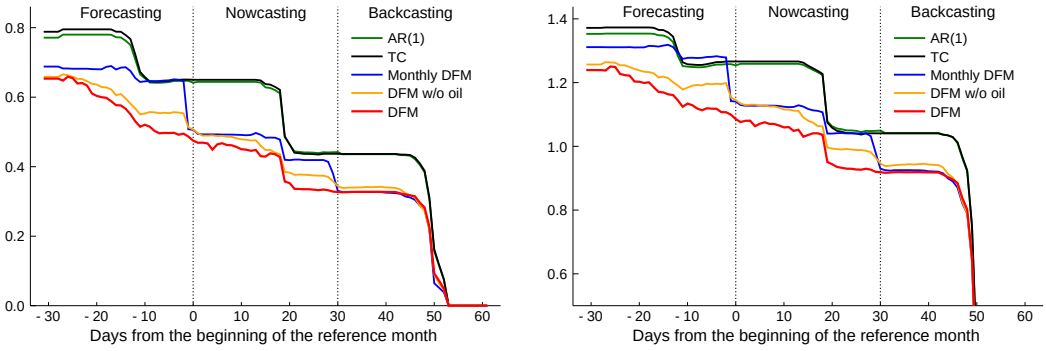
Series	Log Transf.	Dif. Transf.	Filt. Transf.	Avg. Delay
Monthly				
Japan: Consumer Price Index (NSA, 2020=100)	1	1	1	25
Japan: Consumer Price Index: Food Products (NSA, 2020=100)	1	1	1	25
Japan: Domestic Corporate Goods Price Index: Capital Goods (NSA, 2015=100)	1	1	1	11
Japan: Domestic Corporate Goods Price Index: Consumer Goods (NSA, 2015=100)	1	1	1	11
Chile: Consumer Price Index (NSA, 2018=100)	1	1	1	8
Japan: Domestic Corporate Goods Price Index: All Commodities (NSA, 2015=100)	1	1	1	11
Japan: CPI: Reading & Recreation (NSA, 2020=100)	1	1	1	25
Japan: CPI: Clothing & Personal Effects (NSA, 2020=100)	1	1	1	25
Japan: CPI: Food & Beverages (NSA, 2020=100)	1	1	1	25
Japan: General CPI Excluding Food & Energy (NSA, 2020=100)	1	1	1	25
Japan: General CPI: All Items Less Fresh Food and Energy (NSA, 2020=100)	1	1	1	25
Japan: Producers Inventories: Mining & Manufacturing (NSA, 2015=100)	1	1	1	40
Japan: PPI: All Commodities (NSA, 2020=100)	1	1	1	11
Japan: PPI: Manufacturing Industry Products (NSA, 2020=100)	1	1	1	11
Japan: PPI: Beverages and Foods (NSA, 2020=100)	1	1	1	11
Japan: PPI: Plastic Products (NSA, 2020=100)	1	1	1	11
Japan: PPI: Ceramic, Stone and Clay Products (NSA, 2020=100)	1	1	1	11
Japan: PPI: Metal Products (NSA, 2020=100)	1	1	1	11
Japan: PPI: General-Purpose Machinery (NSA, 2020=100)	1	1	1	11
Weekly				
Japan: Gas Station Oil Product Survey: Regular Gasoline: Total Avg (Yen/liter)	1	1	1	4
Japan: SRI+ Hitotsubashi Consumer PEI: Supermarket: Price: Contribution(% Pts)	0	1	1	15
Japan: SRI+ Hitotsubashi Cons Purchase Exp Index: GMS: Price: Contribution(%Pts)	0	1	1	15
Japan: SRI+ Hitotsubashi Cons PEI: Excl Cigarettes: Price: Contribution(% Pts)	0	1	1	15
Japan: POS Retail Sales Index: Home Center: Snack (NSA, 2015=100)	1	1	1	6

Appendix C Performance Accuracy



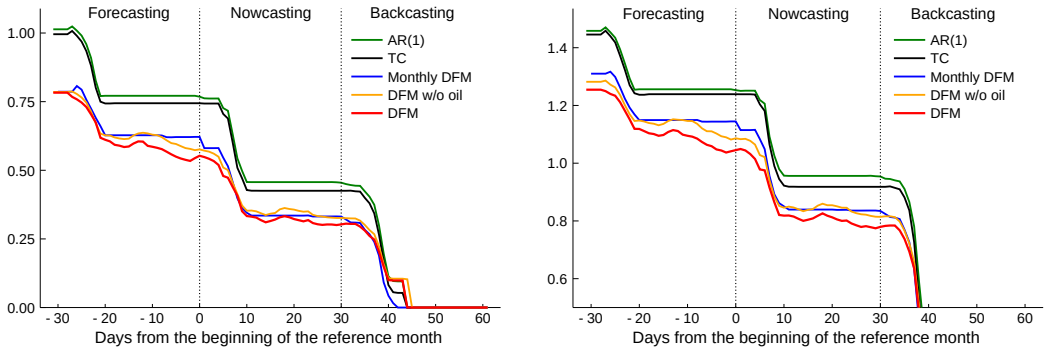
(a) RMSFE **(b)** MASE

Figure 12: US performance.



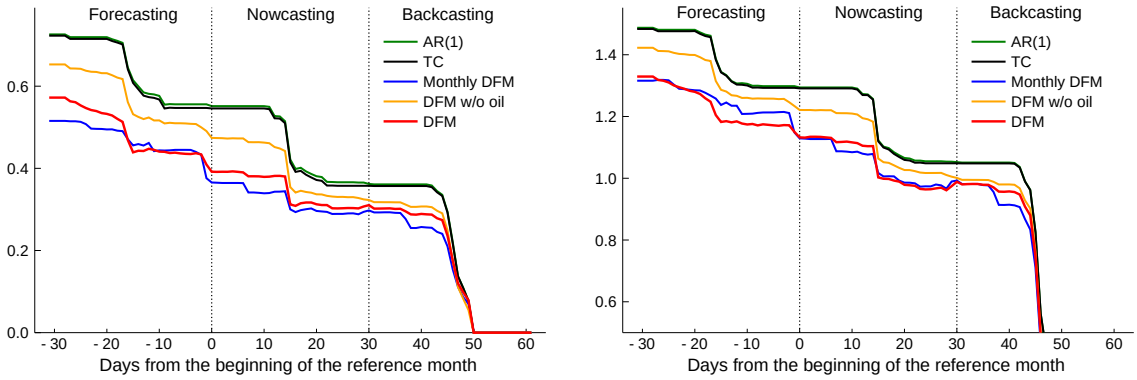
(a) RMSFE **(b)** MASE

Figure 13: Canada performance.



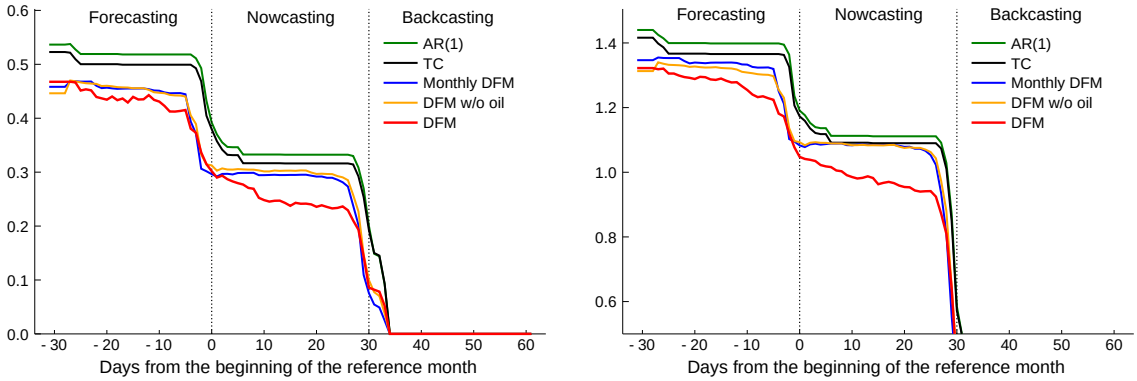
(a) RMSFE **(b)** MASE

Figure 14: Brazil performance.



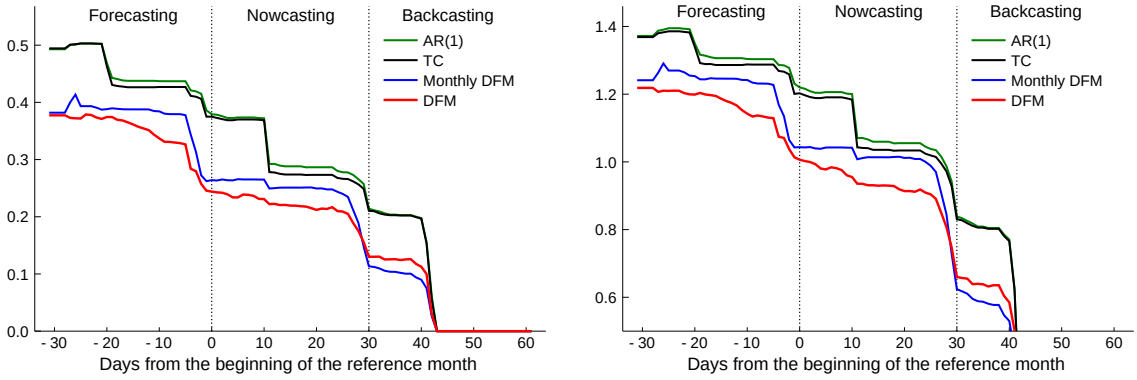
(a) RMSFE **(b)** MASE

Figure 15: UK performance.



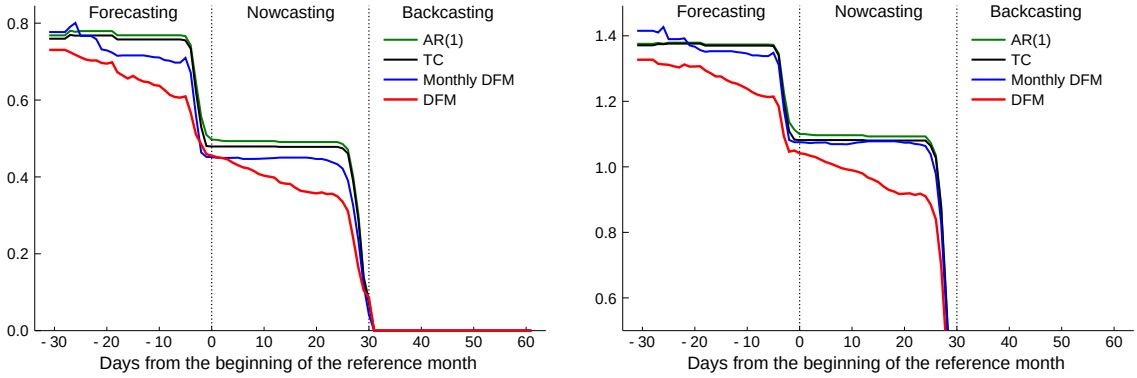
(a) RMSFE **(b)** MASE

Figure 16: EA performance.



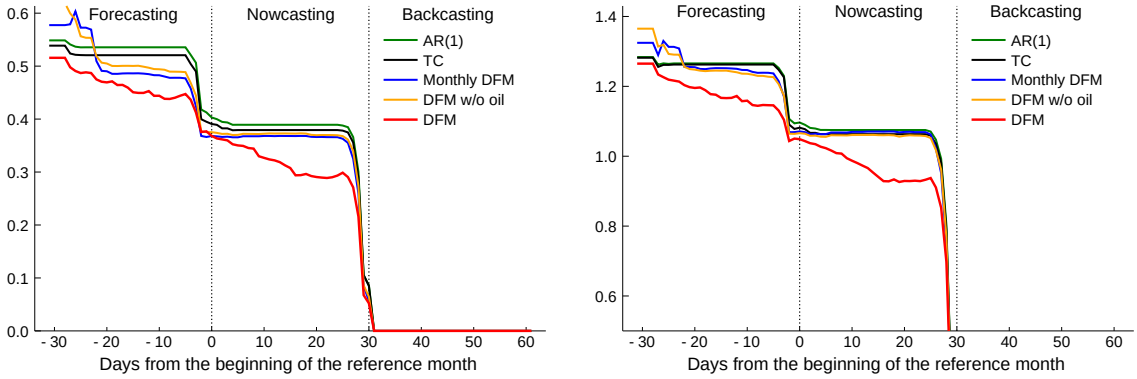
(a) RMSFE **(b)** MASE

Figure 17: France performance.



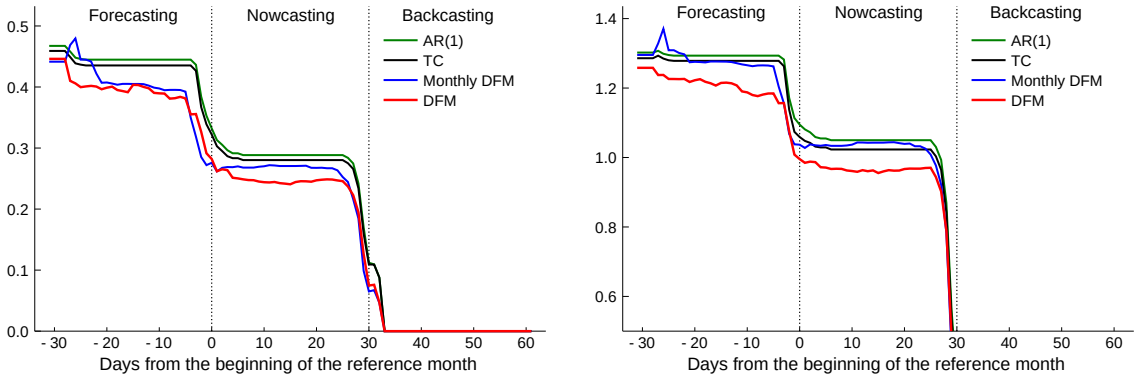
(a) RMSFE **(b)** MASE

Figure 18: Spain performance.



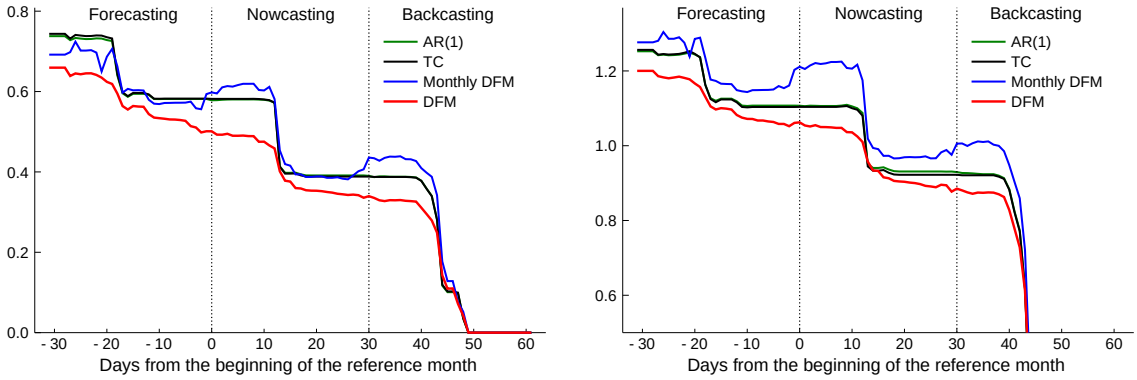
(a) RMSFE **(b)** MASE

Figure 19: Germany performance.



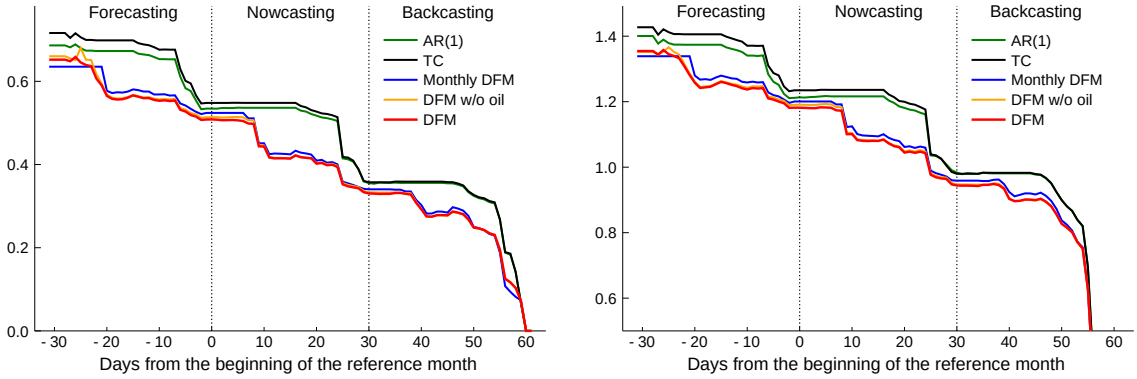
(a) RMSFE **(b)** MASE

Figure 20: Italy performance.



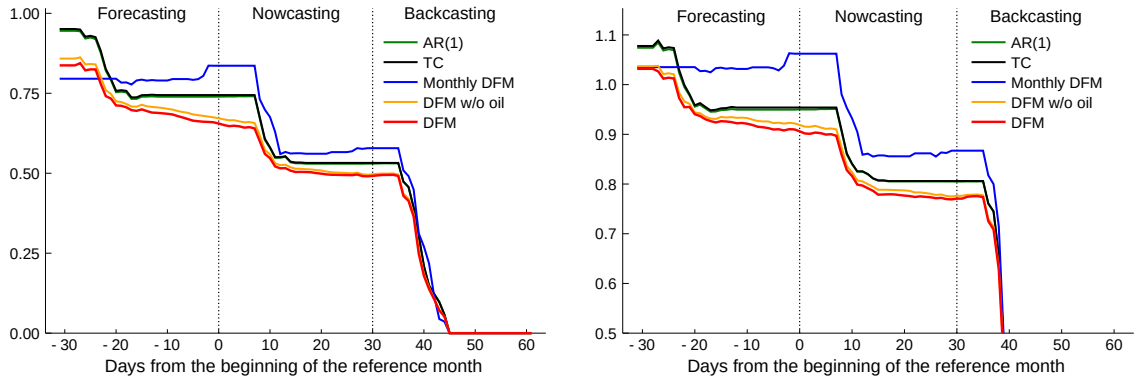
(a) RMSFE **(b)** MASE

Figure 21: Sweden performance.



(a) RMSFE **(b)** MASE

Figure 22: Japan performance.



(a) RMSFE **(b)** MASE

Figure 23: China performance.