Back to the Present: Learning about the Euro Area through a Now-casting Model[1]

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[1]Giannone's contribution to the paper was completed prior to the author joining Amazon. This publication and its contents are not related to Amazon and do not reflect the position of the company and its subsidiaries. The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the view of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System.

Now-casting

- Researchers and policymakers are interested in monitoring the current state of the economy in an accurate and timely manner
- However, GDP is typically measured at a quarterly frequency and is released with a substantial delay
- **Now-casting**: internally consistent econometric framework that:
  1. tracks and digests the daily flow of numerous **market-moving indicators**
  2. re-assess the state of the economy based on whether data releases were **better or worse-than-expected**

Now-casting Euro Area GDP is notably challenging

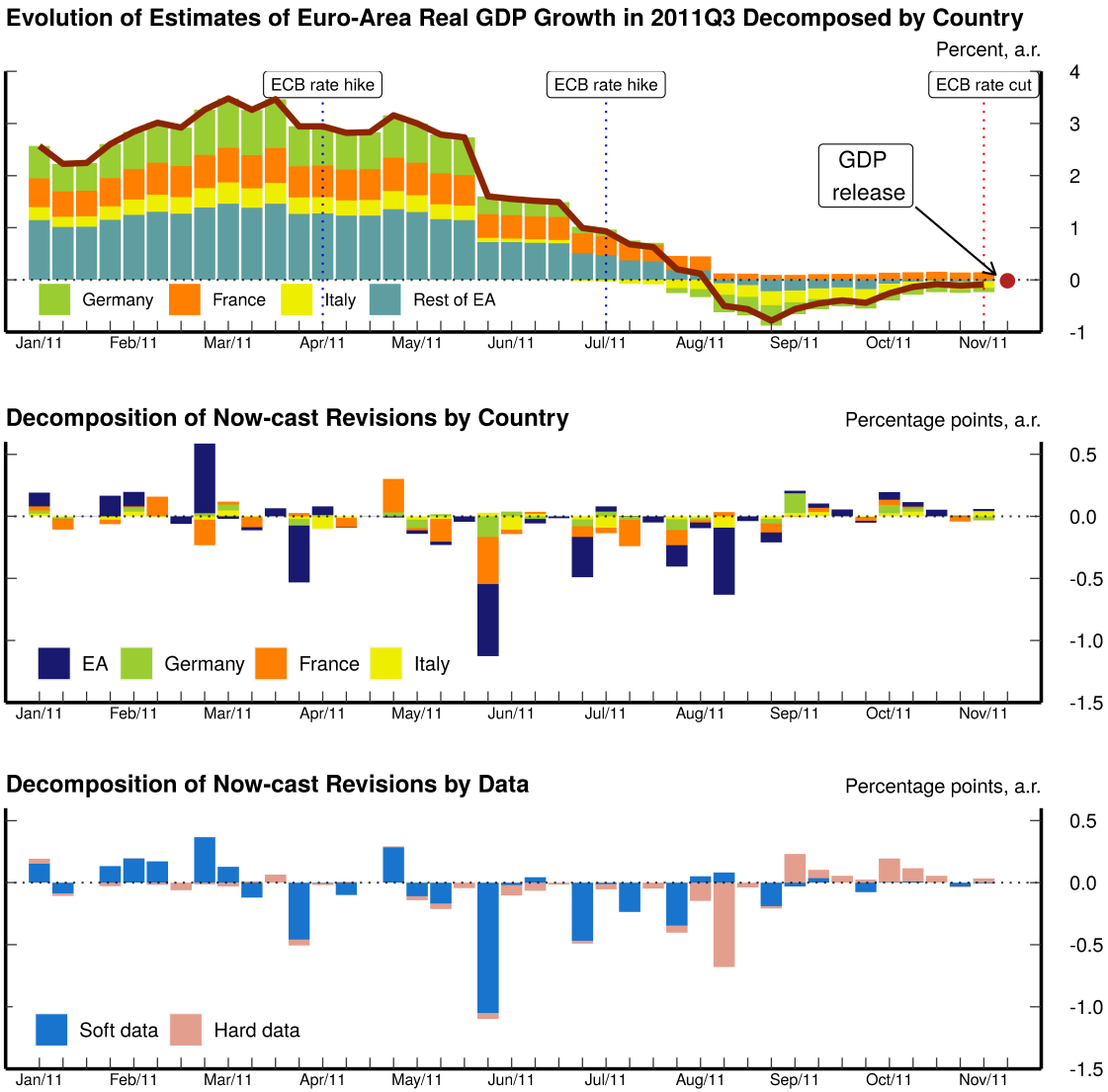
- Hard data is released with a substantial delay
- Economists **always** follow market-moving indicators including both aggregate and country-specific data
- The ECB's forecast for the euro area, for example, is built from the projections for individual countries
- However, scholars have focused only on **single-economy models** for the euro area aggregate and particular member countries:
  - **Euro area:** Angelini, Bańbura, and Rünstler, 2010; Camacho and Perez-Quiros, 2010; Angelini, Camba-Mendez, Giannone, Reichlin, and Rünstler, 2011; Bańbura and Rünstler, 2011; Bańbura and Modugno, 2014; Carriero, Galvao, and Kapetanios, 2019
  - **Germany:** Marcellino and Schumacher, 2010; Andreini, Senftleben-König, Hasenzagl, Reichlin, and Strohsal, 2020
  - **France:** Barhoumi, Darné, and Ferrara, 2010; Bessec and Doz, 2014
  - **Multiple euro area economies:** Rünstler, Barhoumi, Benk, Cristadoro, Den Reijer, Jakaitiene, Jelonek, Rua, Ruth, and Van Nieuwenhuyze, 2009; Jansen, Jin, and de Winter, 2016

This Paper

What we do:

- We model **simultaneously** the economic conditions of the euro-area aggregate and its three largest member countries—Germany, France, and Italy
- We "formalize" what market participants are doing "informally" when monitoring the economic conditions of the euro area
- **Dynamic Factor Model (DFM)**, with euro area and country-specific data considered **important by the market**, and particular features of the data accommodated **within our framework**.

Example: In 2011, ECB Tightened Policy



- Apr-2011: rate lift-off
  - head/core inflation=2.7/1.5%
  - GDP growth $\approx$ 3%
  - to *"maintain inflation rates below, but close to, 2%"*
- Jul-2011: rate hike
  - GDP growth: $\downarrow$ fast
  - communication: similar
- Aug, Sep, Oct: steady
  - GDP growth: $\downarrow$ fast
- Nov-2011: cut rate

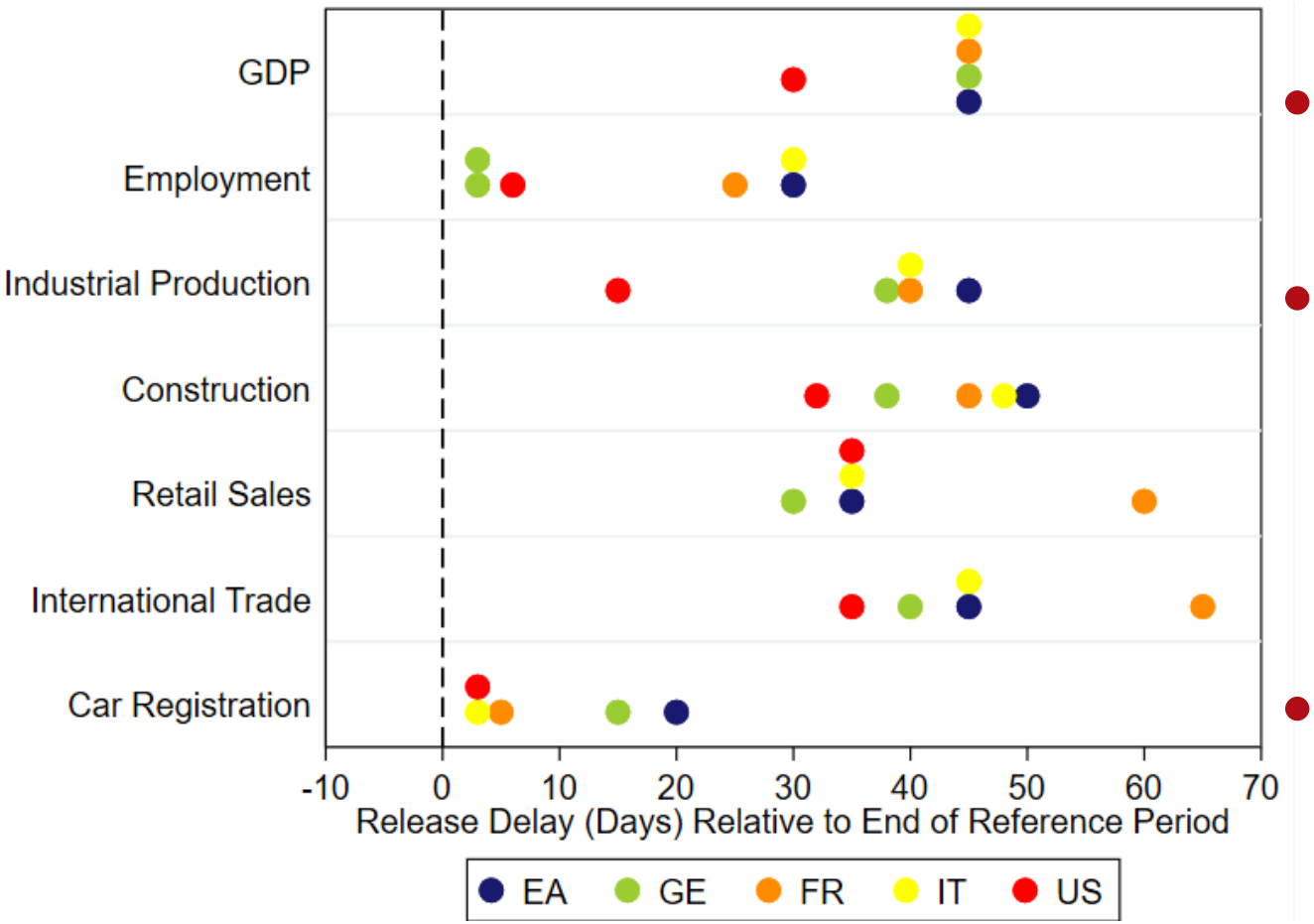
Choice of Variables

- We focus on data considered "important" by policymakers and market participants—market moving indicators
- Focus on main EA economies: GDP of Germany, France and Italy represent about 64% of the total euro area GDP, and 87% of the 9-country flash estimate
- Selection criteria based on the Bloomberg Relevance Index—the percentage of Bloomberg users automatically notified of a specific data release
- **58 series:** EA = 13, GE = 15, FR = 16, IT = 14

▸ Table with Full Data Description

1st Feature: Interest in aggregate Euro Area **AND** Major Countries

Release Delay of Variables by Country



- Data significantly delayed in comparison to U.S.
- Data from major countries earlier than EA

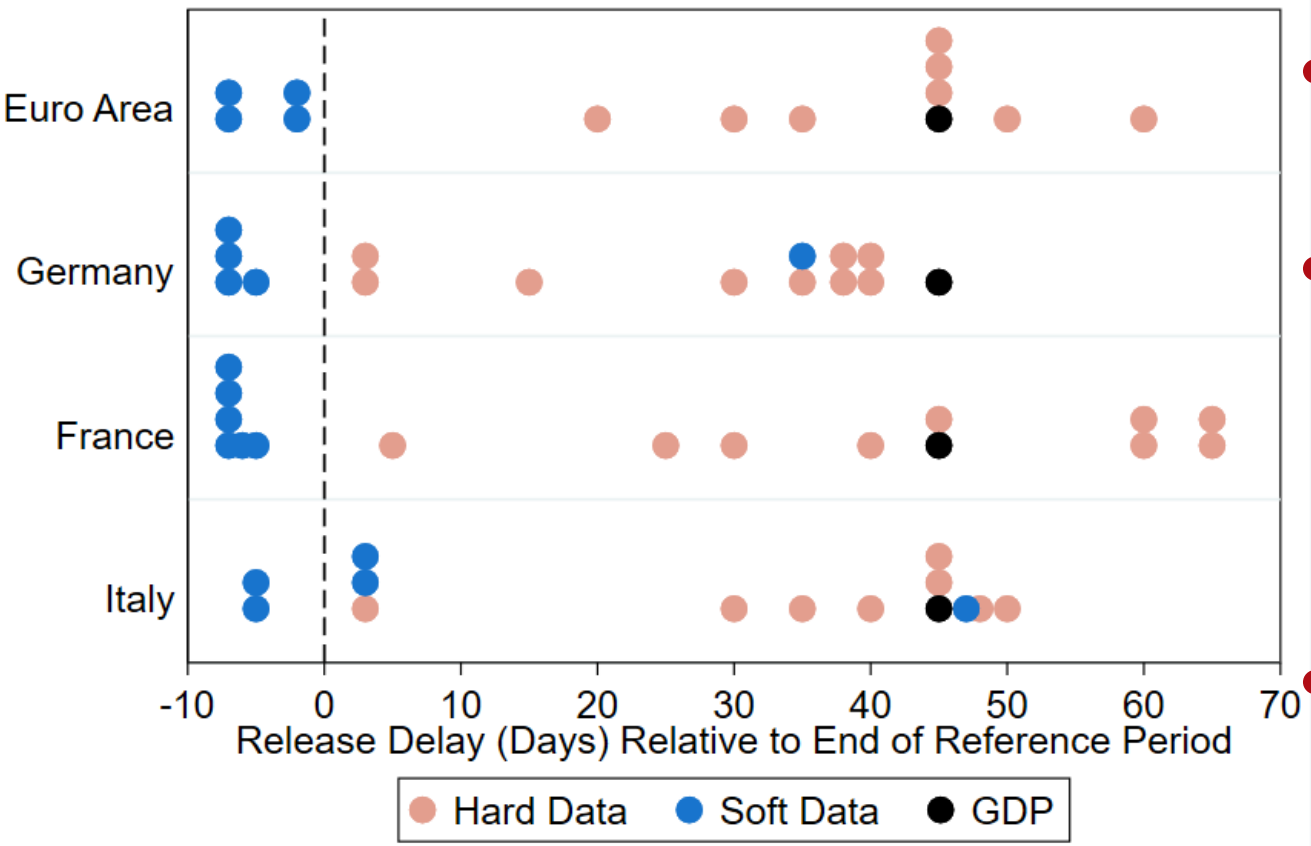
How we tackle it:

- Model EA, Germany, France and Italy **jointly**

Note: Shaded area represents now-cast periods (current quarter forecast).

2nd Feature: Non-Synchronicity

Release Delay of Variables by Data Type



- hard data comes with substantial delay
- Soft data is well-advanced to GDP

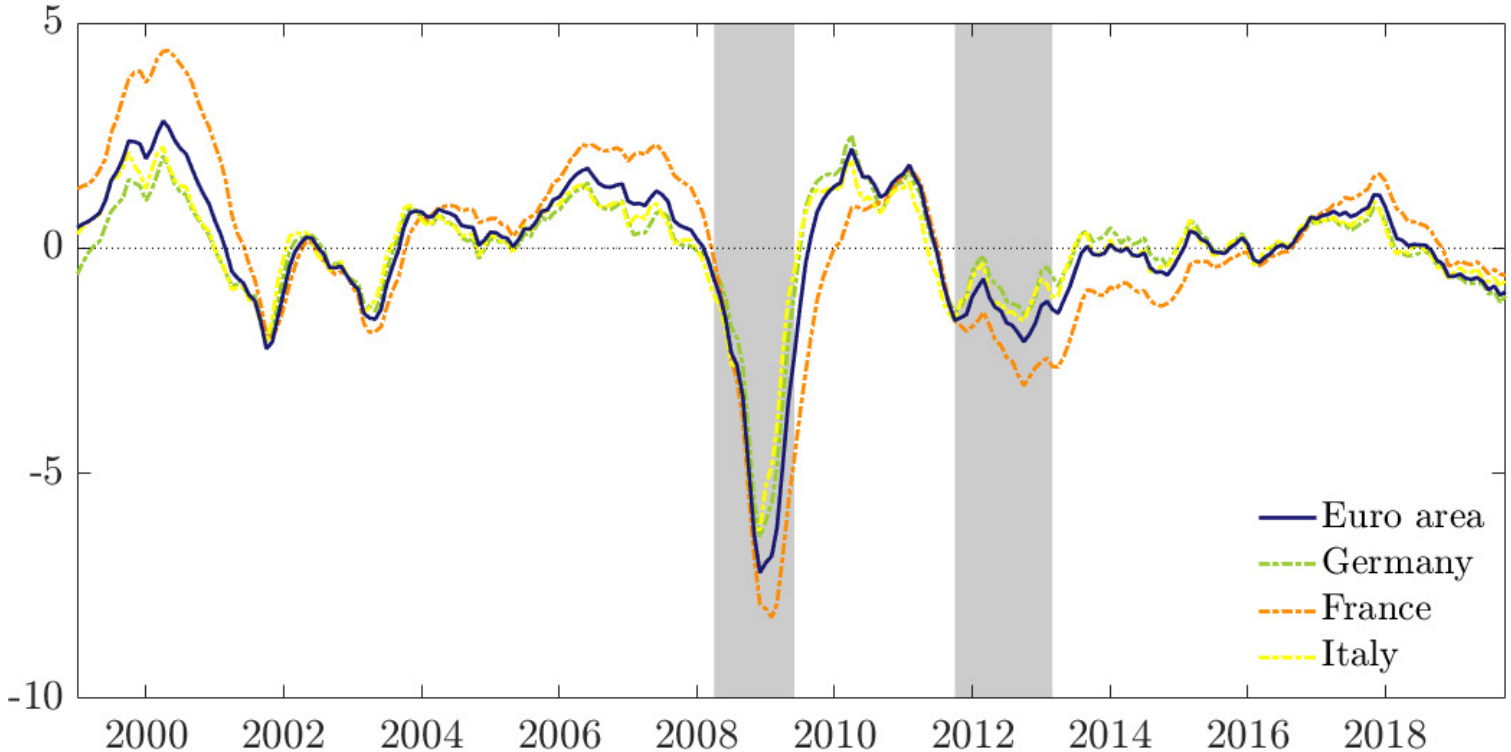
How we tackle it:

- Model rich in **soft data**

Note: Shaded area represents now-cast periods (current quarter forecast).

3rd Feature: Dynamic Heterogeneity

Common Factors Specific to Euro Area/Countries



Note: Shaded areas are euro area recession periods as dated by the Center for Economic and Policy Research (CEPR).

- EA lags GE and IT, but leads FR
- GE and IT quite synchronised
- FR lags other countries (e.g., GFC)

How we tackle it:

- Allow a **lead-lag relationship** among the euro area/countries

General Dynamic Factor Model (DFM):

$$\begin{bmatrix} \mathbf{y_t^{(m)}} \\ \mathbf{y_t^{(q)}} \end{bmatrix} = \begin{bmatrix} \Lambda^{(m)} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \Lambda^{(q)} & 2\Lambda^{(q)} & 3\Lambda^{(q)} & 2\Lambda^{(q)} & \Lambda^{(q)} \end{bmatrix} \begin{bmatrix} \mathbf{f_t} \\ \vdots \\ \mathbf{f_{t-4}} \end{bmatrix} + \begin{bmatrix} \mathbf{e_t^{(m)}} \\ \mathbf{e_t^{(q)}} \end{bmatrix}$$

$$\mathbf{f_t} \sim \text{VAR(p)} \qquad \mathbf{e_t^{(m)}}, \mathbf{e_t^{(q)}} \sim \text{AR(1)}$$

where
- data $\mathbf{y} = [\mathbf{y^{(m)}}\ \mathbf{y^{(q)}}]$ may have "ragged edge"
- $\mathbf{f_t}$ is latent common factor
- $\mathbf{y_t^{(m)}}$ and $\mathbf{y_t^{(q)}}$ are monthly and quarterly data, resp.

Benchmark Model: Heterogenous DFM

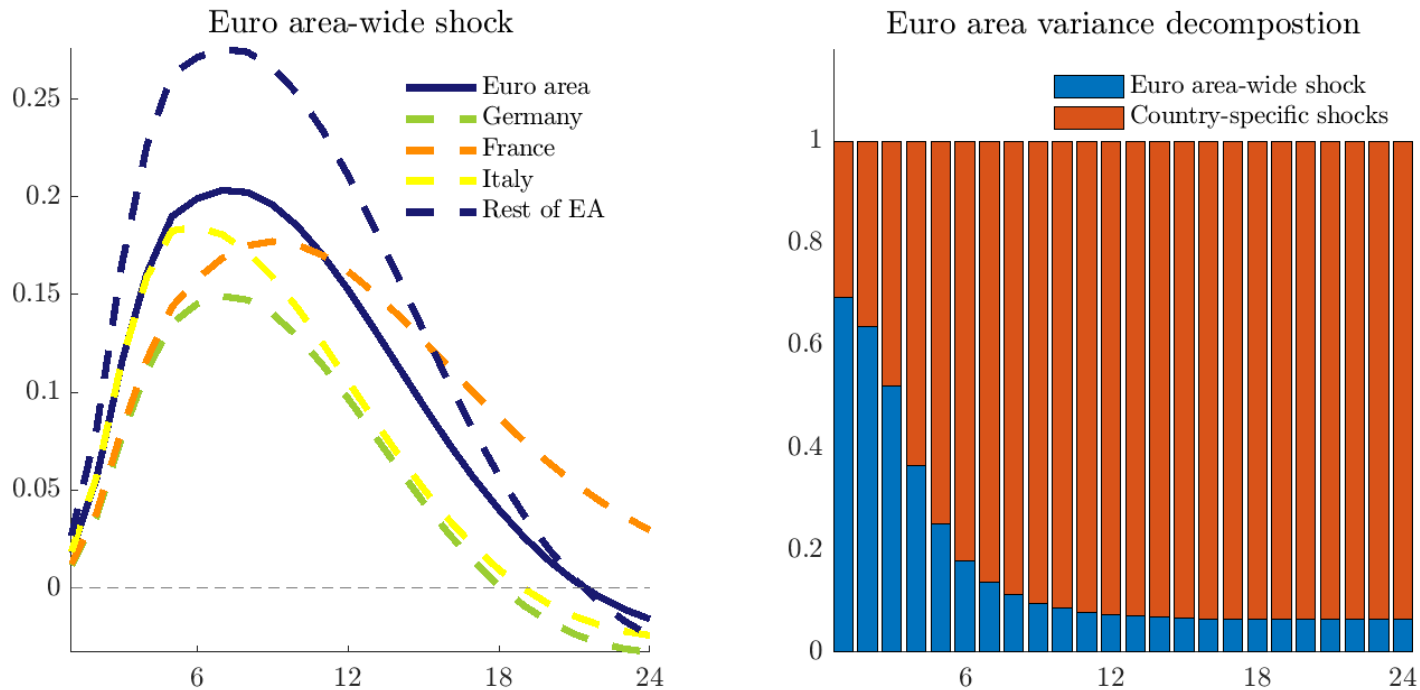
$$\begin{bmatrix} \mathbf{y_t^{ea}} \\ \mathbf{y_t^{fr}} \\ \mathbf{y_t^{ge}} \\ \mathbf{y_t^{it}} \end{bmatrix} = \begin{bmatrix} \Lambda^{\text{ea}} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \Lambda^{\text{fr}} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \Lambda^{\text{ge}} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \Lambda^{\text{it}} \end{bmatrix} \begin{bmatrix} \mathbf{f_t^{ea}} \\ \mathbf{f_t^{fr}} \\ \mathbf{f_t^{ge}} \\ \mathbf{f_t^{it}} \end{bmatrix} + \begin{bmatrix} \mathbf{e_t^{ea}} \\ \mathbf{e_t^{fr}} \\ \mathbf{e_t^{ge}} \\ \mathbf{e_t^{it}} \end{bmatrix}$$

$$\mathbf{f_t^c} = [\text{f}_t^{\text{c}} \quad \dots \quad \text{f}_{t-4}^{\text{c}}]', \qquad \text{for c = ea, ge, fr, it}$$

$$\mathbf{f_t} = [\text{f}_t^{\text{ea}} \quad \text{f}_t^{\text{fr}} \quad \text{f}_t^{\text{ge}} \quad \text{f}_t^{\text{it}}]' \sim \text{VAR(1)}$$

Substantial Dynamics Across Countries

Stock and Watson (2005) Factor-Structural VAR model: decomposition between euro area-wide and country-specific shocks

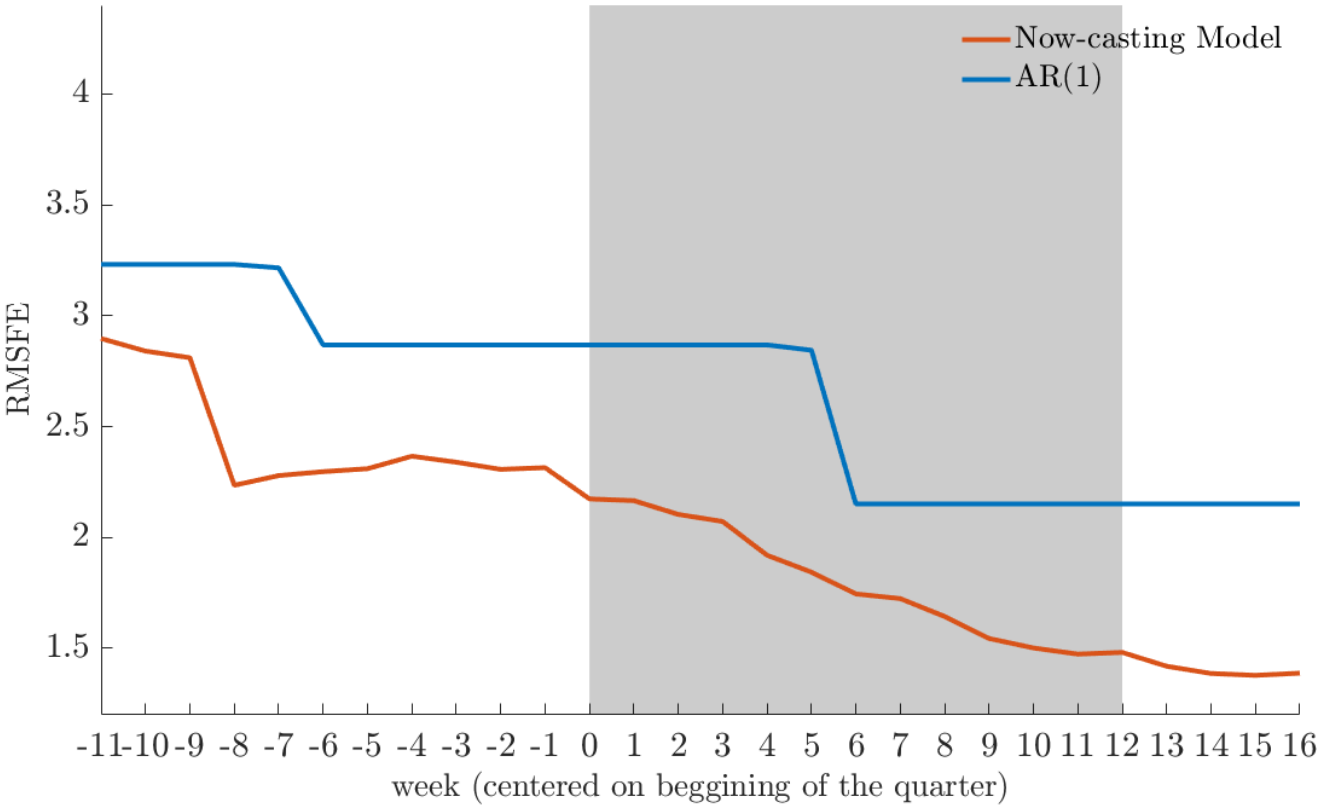


Note: On the left, impulse response functions to GDP growth after an euro area-wide shock up to 24 months ahead. On the right, variance decomposition of the euro area GDP growth between the euro area-wide and the total of country-specific shocks.

- EA-wide shocks induce effects that differ in size and timing
- Country-specific spillovers also explain EA GDP growth

Modeling Economies Together Improves the Now-cast

Pseudo-out-of-sample RMSFEs: EA

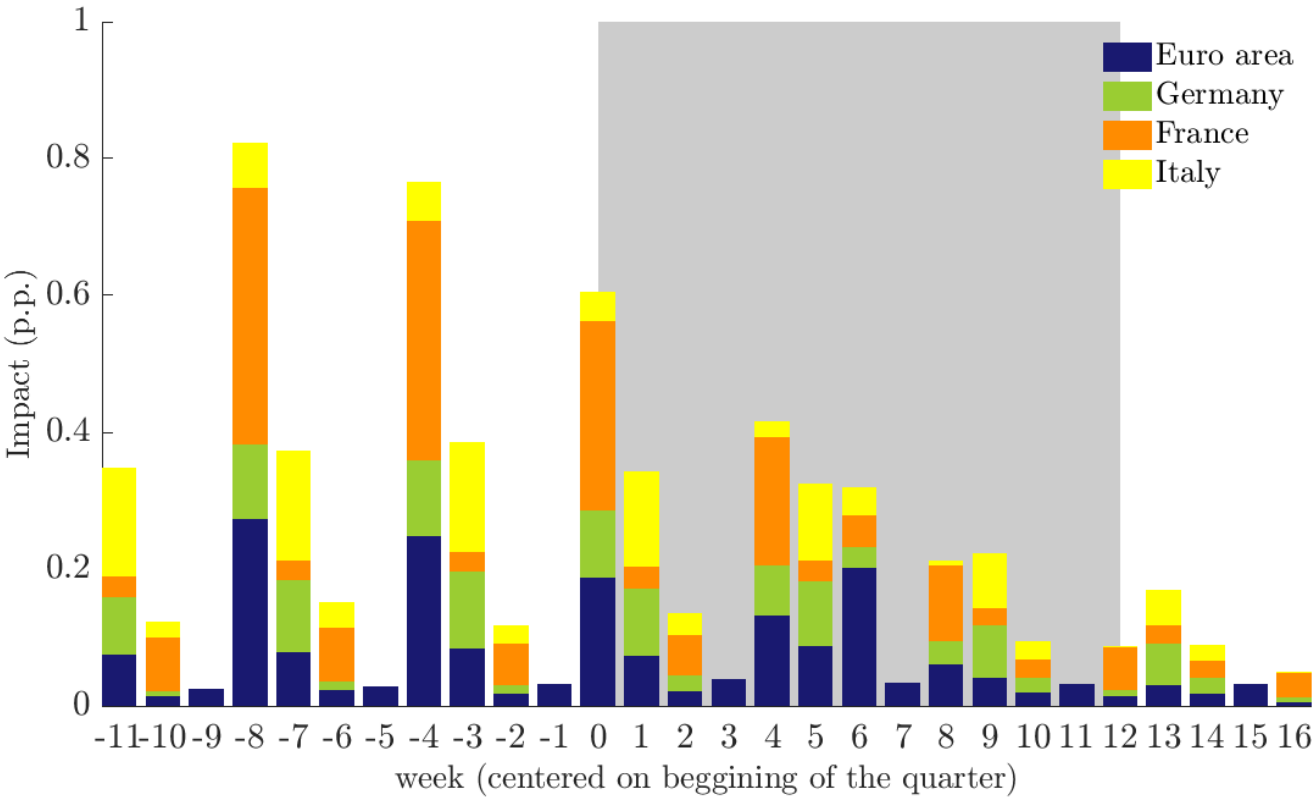


- RMSFEs:
  - decrease over time
- Substantial gains over AR(1)

Note: Shaded area represents now-cast periods (current quarter forecast).

Country Data Matters for Now-casting EA GDP

News Decomposition: EA



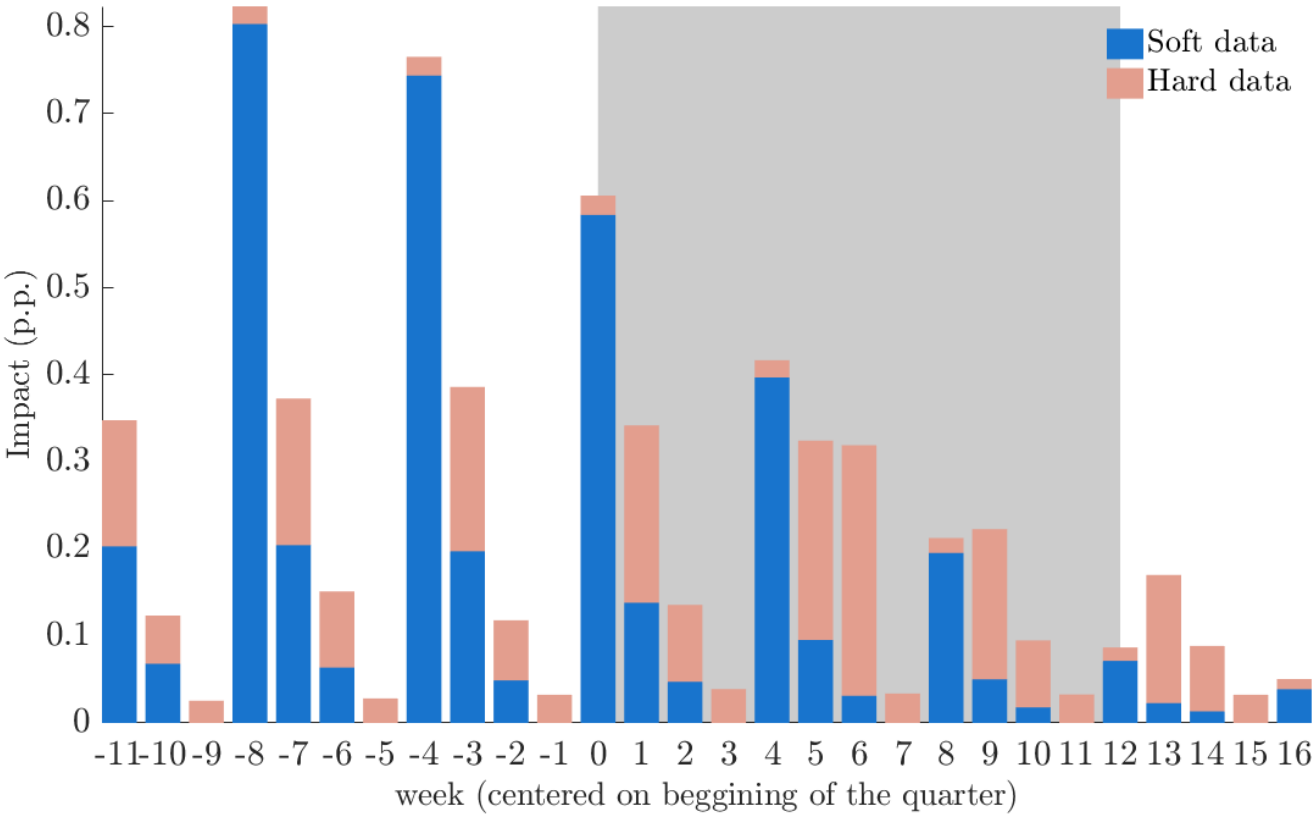
- News impact of variable x: $= \text{ave}(|\text{weight}_x|) \cdot \text{std}(\text{FE}_x)$
- Generally, news impact...
  ...decreasing $\rightarrow$ backcast
- News of soft data
  $>$ hard data until week 4
- After week 4, "no news"

Note: Shaded area represents now-cast periods (current quarter forecast).

Soft Data is Important for Now-casting EA GDP

Its data releases have large effects on the model's forecasts

News Decomposition: EA

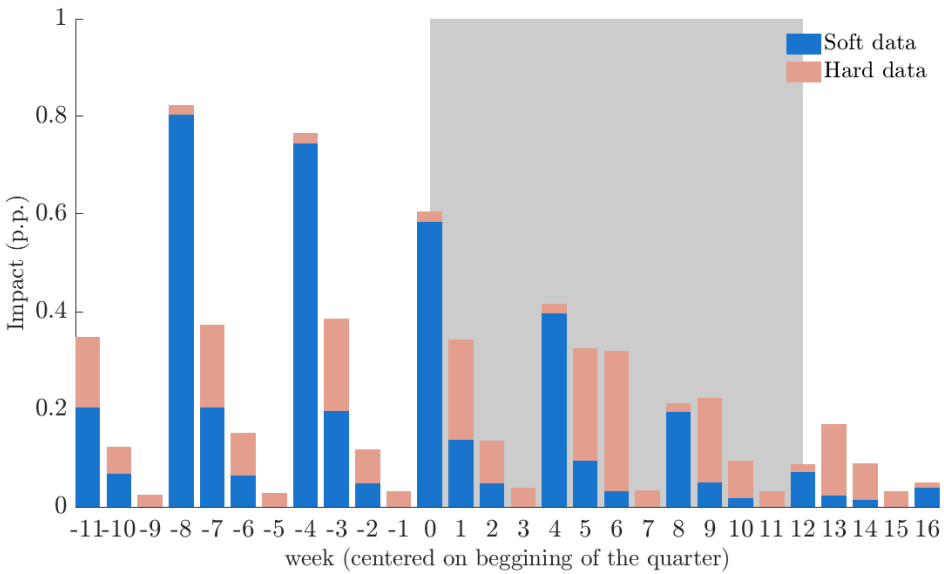


- News impact of variable x:
  $= \text{ave}(|\text{weight}_x|) \cdot \text{std}(\text{FE}_x)$
- Generally, news impact...
  ...decreasing $\rightarrow$ backcast
- News of soft data
  $>$ hard data until week 4
- After week 4, "no news"

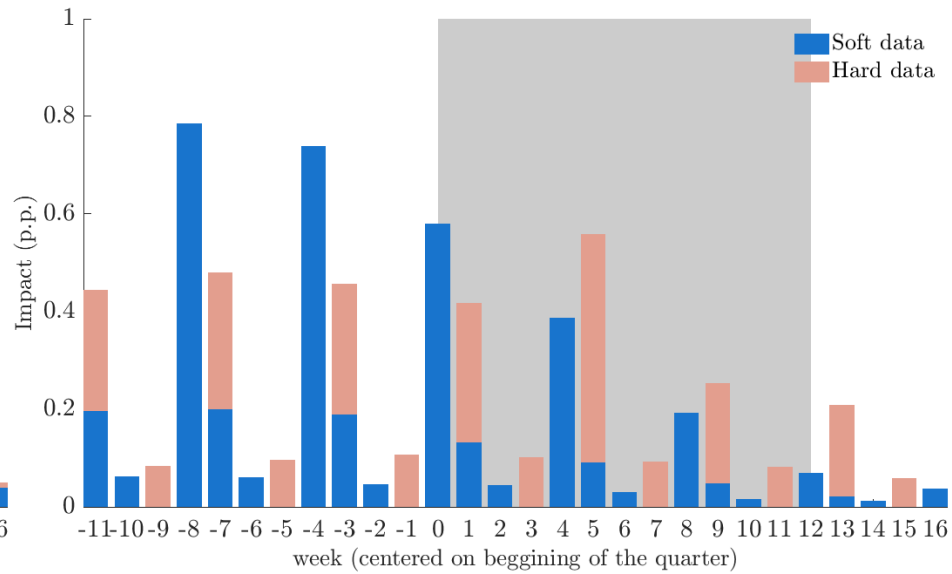
Note: Shaded area represents now-cast periods (current quarter forecast).

Soft Data is Important for Now-casting EA GDP

Counterfactual dataset: hard data releases anticipated to match U.S. schedule



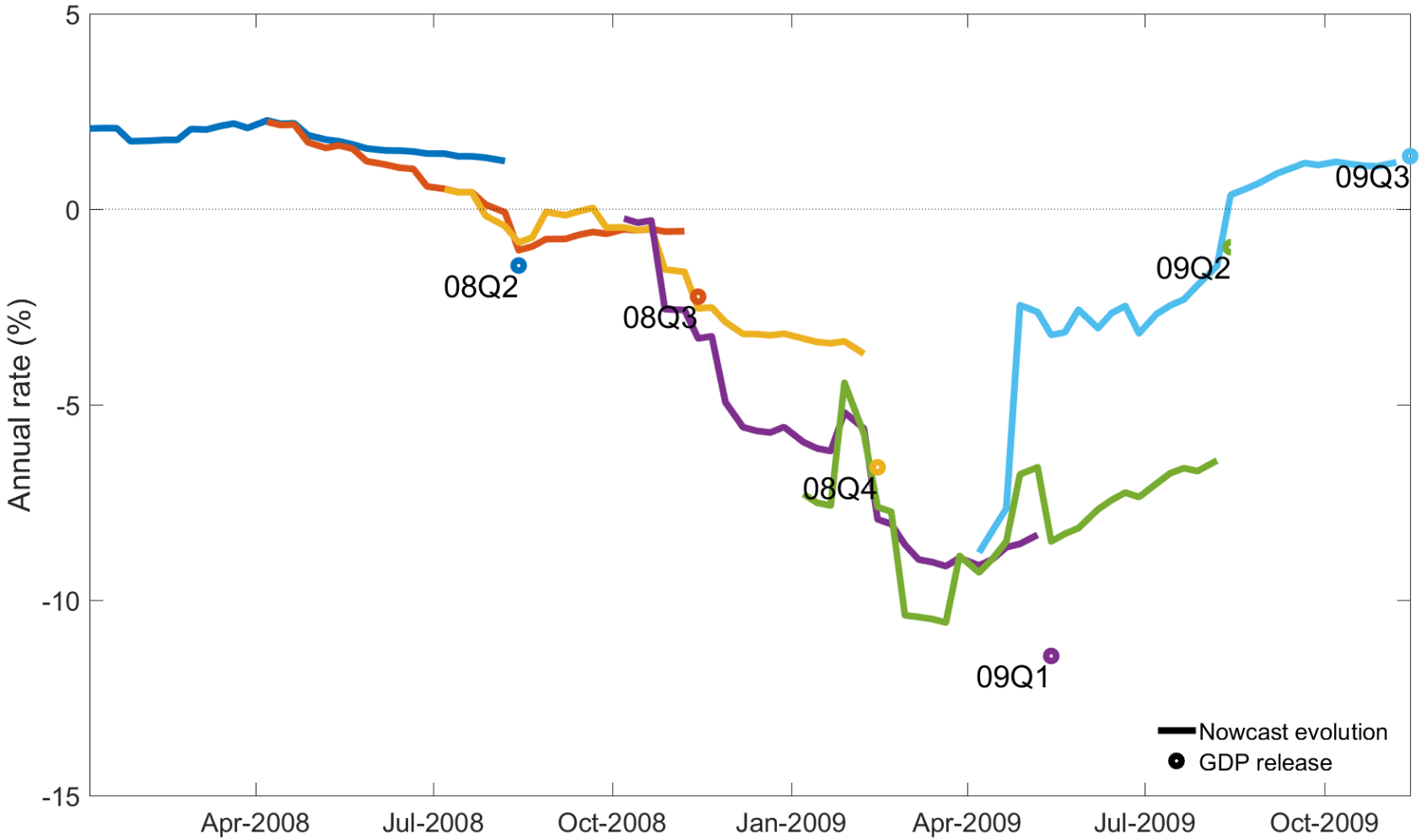
(a) EA Baseline



(b) EA Counterfactual

- Soft data remain important even under the counterfactual
- Hard data lead to larger news earlier on
- "Less news" after week 5

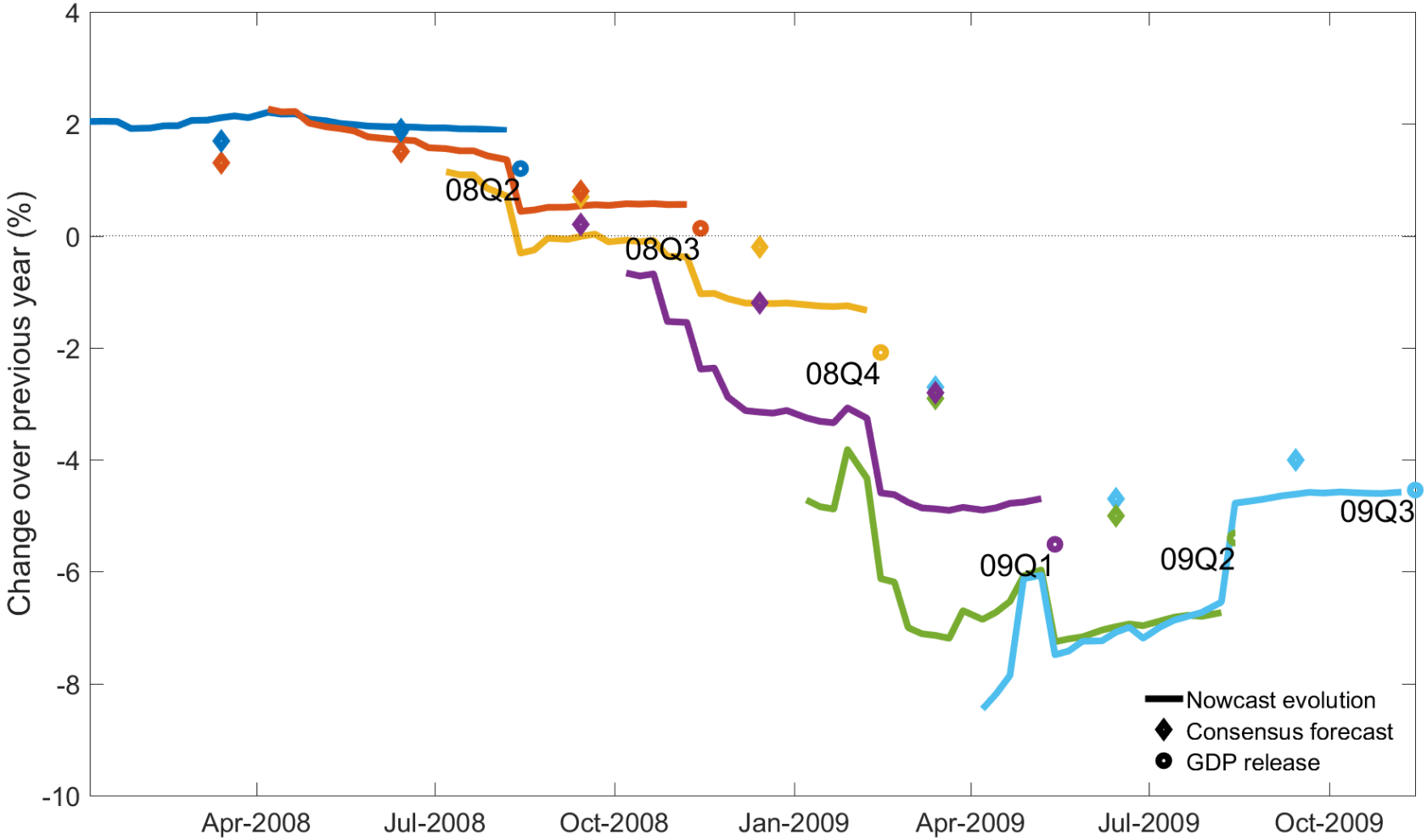
Model Tracked GFC Slowdown and Recovery…



Note: Now-cast evolution comes from the heterogeneous dynamic factor model (benchmark model). Each line corresponds to a different evolution of an out-of-sample forecast of quarter-on-quarter GDP growth of the euro area for the period 2008Q2 to 2009Q3. Dots represent the realized quarterly GDP growth for the period.

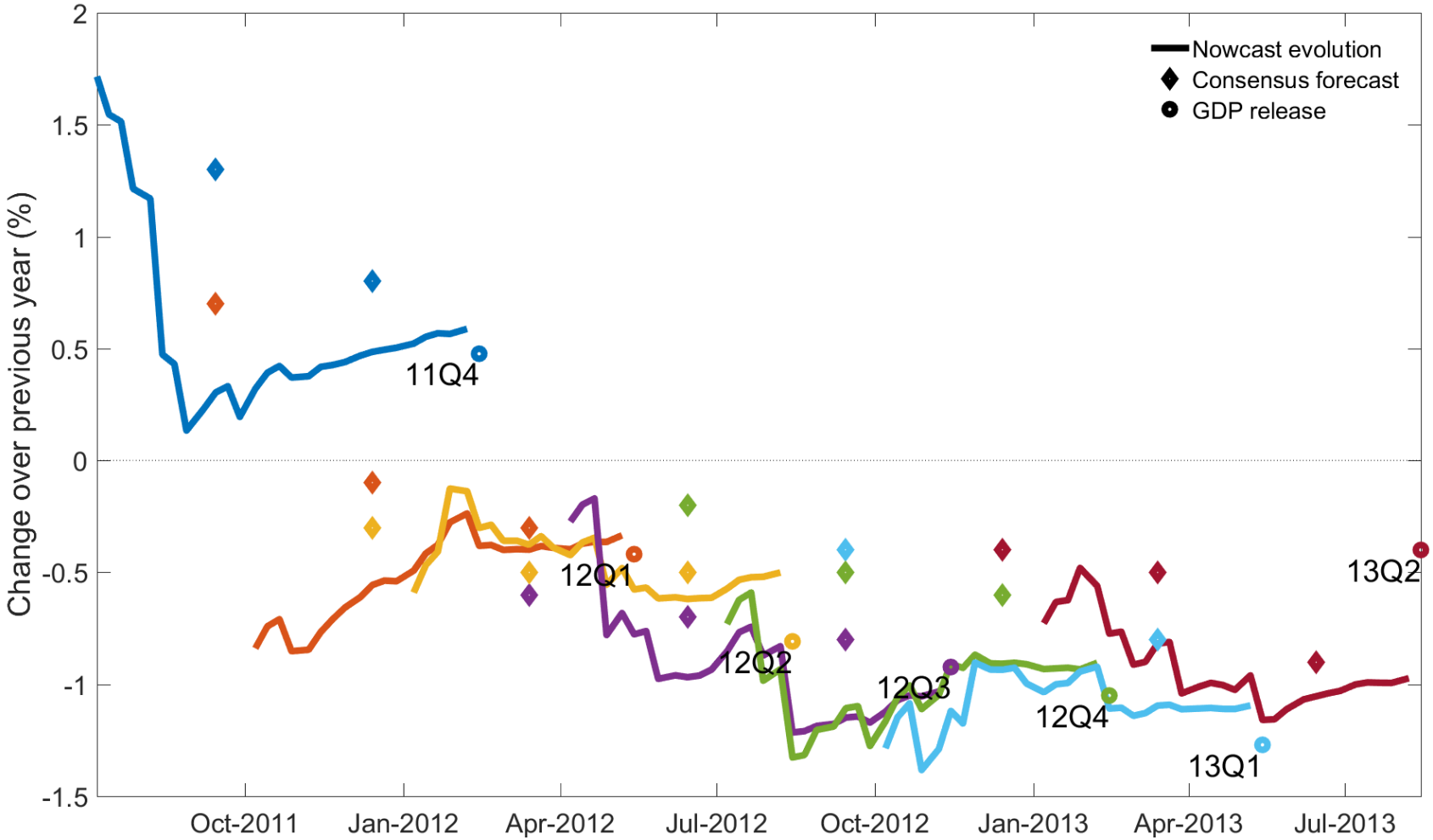
. . . With Performance Similar to Consensus. . .

. . . and a bit better in the trough of the recession: 2008Q4–2009Q1



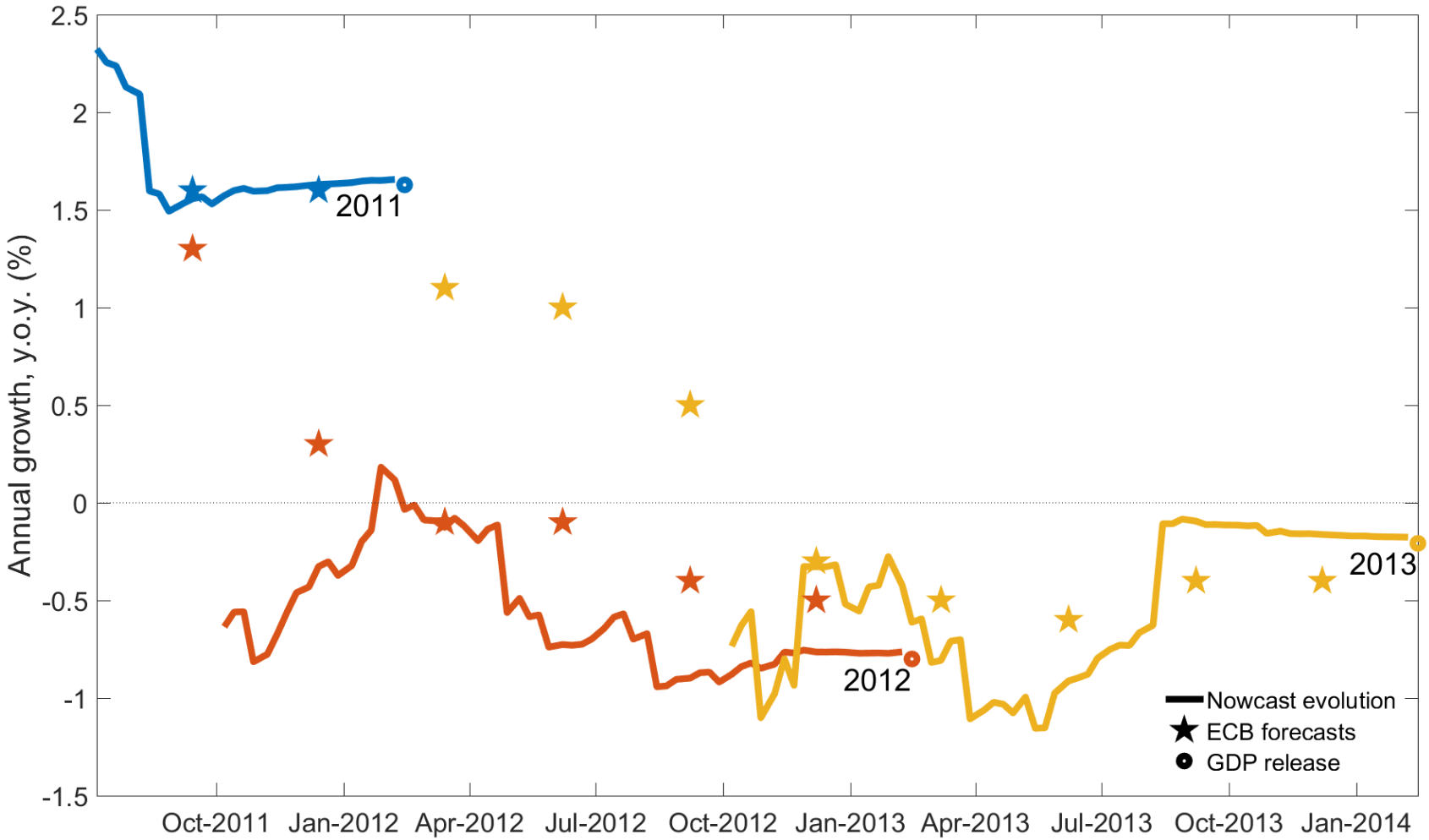
Note: Now-cast evolution comes from the heterogeneous dynamic factor model (benchmark model). Each line corresponds to a different evolution of an out-of-sample forecast of 4-quarter GDP growth of the euro area for the period 2008Q2 to 2009Q3. Dots represent the realized 4-quarter GDP growth for the period. Diamonds represent the forecast of 4-quarter GDP growth from Consensus at the time they were published.

Model Signalled 2011 Slowdown Before Consensus



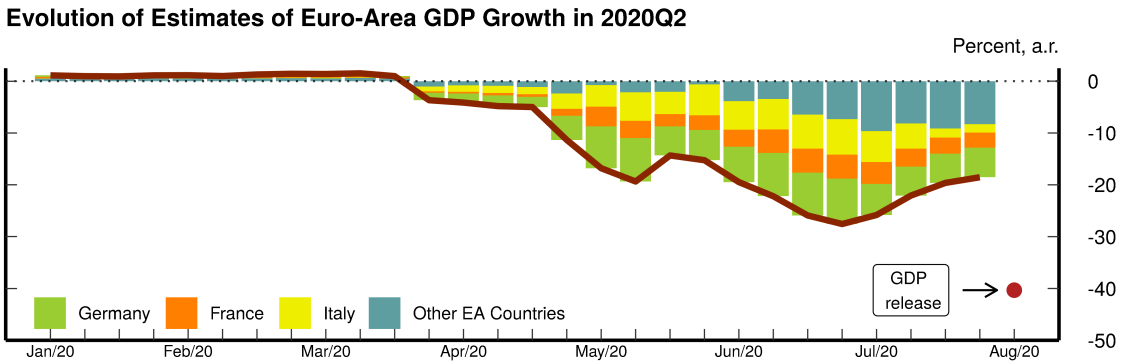
Note: Now-cast evolution comes from the heterogeneous dynamic factor model (benchmark model). Each line corresponds to a different evolution of an out-of-sample forecast of 4-quarter GDP growth of the euro area for the period 2011Q4 to 2013Q2. Dots represent the realized 4-quarter GDP growth for the period. Diamonds represent the forecast of 4-quarter GDP growth from Consensus at the time they were published.

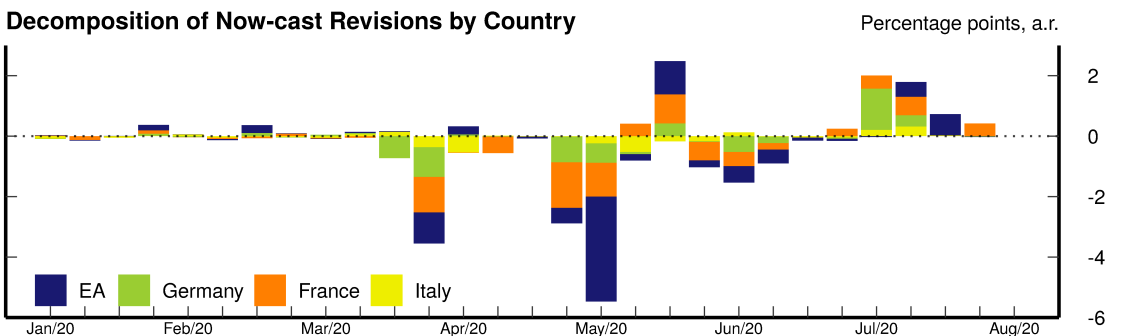
Model Signalled 2011-12 Slowdown Before ECB

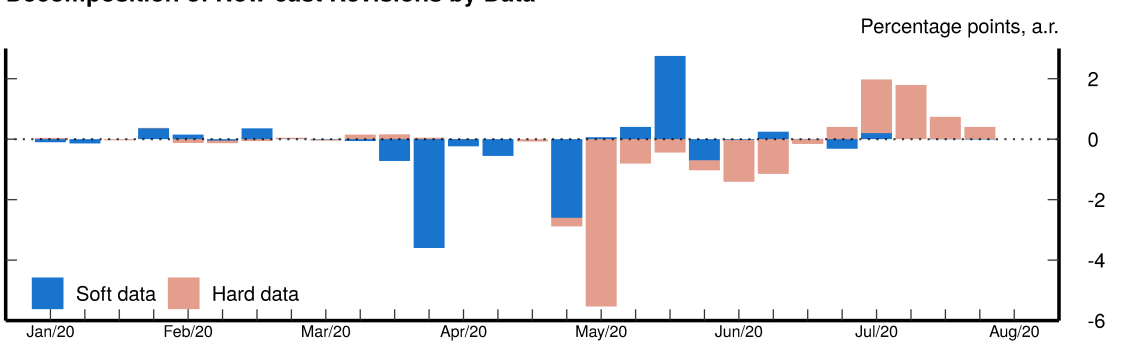


Note: Now-cast evolution comes from the heterogeneous dynamic factor model (benchmark model). Each line corresponds to a different evolution of an out-of-sample forecast of the year-over-year GDP growth of the euro area for the period 2011Q4 to 2013Q2. Dots represent the realized year-over-year GDP growth for the period. Stars represent the forecast of year-over-year GDP growth from the ECB at the time they were published.

Sudden Stop in Activity due to COVID-19

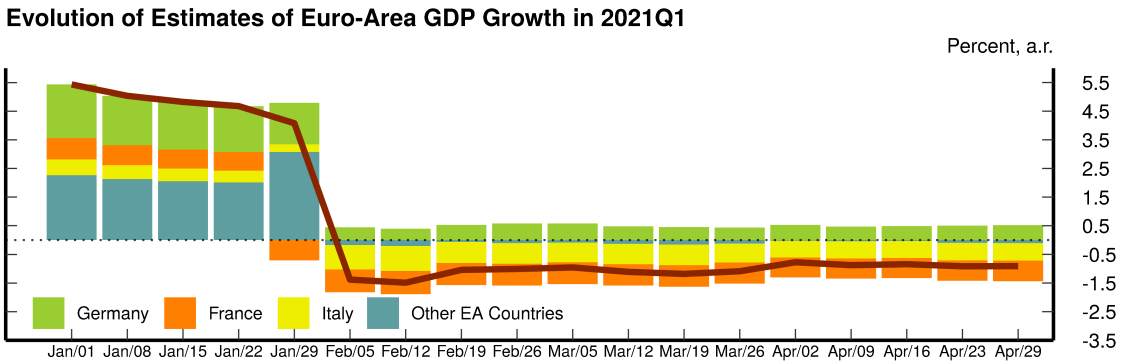


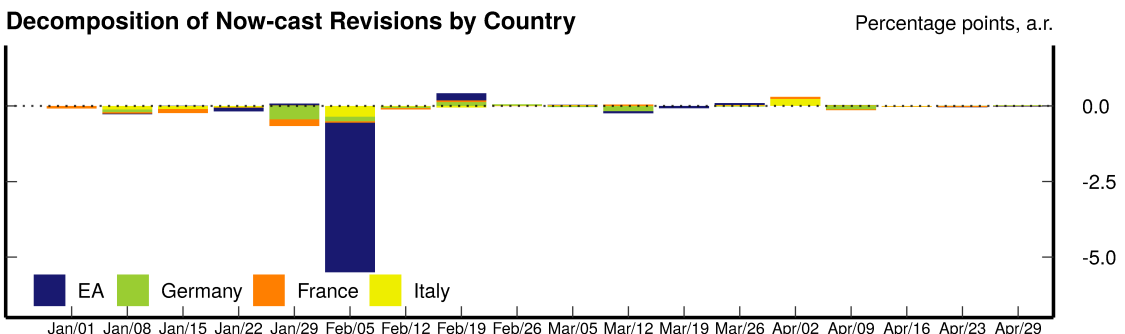


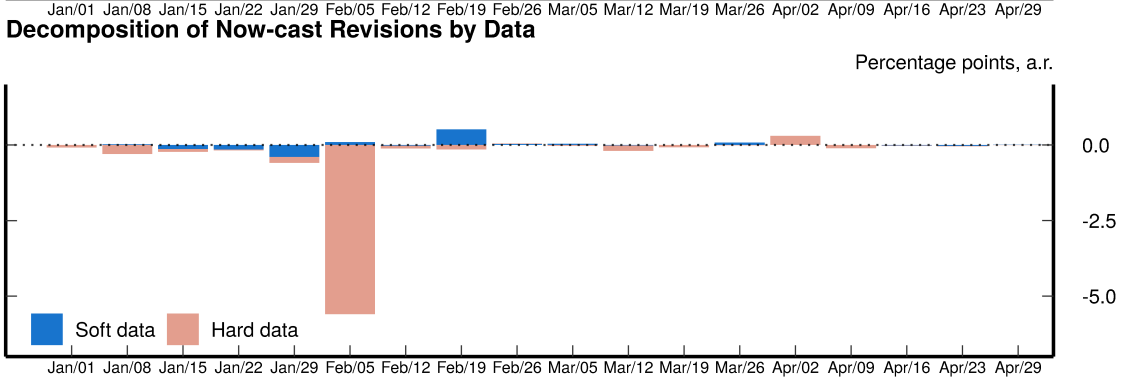


- Model: daily estimates of GDP growth consistent with available data
- Soft data:
  - important for now-casting
- ECB, 18 March 2020:
  - *"economic activity across the euro area would decline considerably"*
  - launched its (new) PEPP

2021 forecasts







- **2021:Q1:** Model indicated a contraction around 1%, close to the flash release of -2.5%
- More importantly, the model already 'knew it' since Feb/05
- **2021:Q3** Currently pointing to a 7.0% expansion (a.r.)

Conclusion

We propose a now-casting model for the euro area and its main economies with three main characteristics:

- Jointly estimates the euro area and its main economies
- Focus on market-moving indicators
- Allow for dynamic heterogeneity in data for aggregate/countries

By tackling these features, we provide now-casts comparable to private forecasters in historical events

Soft data is important for now-casting EA GDP

Weekly updates available at sites.google.com/view/euroareanowcast

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Appendix

Country	Series Name	Units	Freq.	Transf.	Delay	Relevance	Category
EA	Gross Domestic Product	SWDA, Mil.Ch.2010.EUR	q	pca	30	92.5	Hard Data
EA	Unemployment Rate	SA, %	m	lin	30	67.5	Hard Data
EA	Industrial Turnover: Manufacturing	SWDA, 2015=100	m	pch	60	75	Hard Data
EA	IP: Industry excluding Construction	SA/WDA, 2015=100	m	pch	45	62.5	Hard Data
EA	Industrial Production: Construction	SA/WDA, 2015=100	m	pch	50	15	Hard Data
EA	PMI: Manufacturing Flash	SA, 50+=Expansion	m	lin	-7	90	Soft Data
EA	PMI: Services Business Activity Flash	SA, 50+=Expansion	m	lin	-7	70	Soft Data
EA	Retail Sales Volume Index	SA/WDA, 2015=100	m	pch	35	50	Hard Data
EA	Consumer Confidence Indicator, % Balance	SA, %	m	lin	-2	75	Soft Data
EA	Business Climate Indicator	SA, std-dev pts	m	lin	-2	30	Soft Data
EA	Exports of Goods	SA/WDA,Thous.EUR	m	pch	45	82	Hard Data
EA	Imports of Goods	SA/WDA, Thous.Euros	m	pch	45	25	Hard Data
EA	EU 28 excl Malta: New Passenger Car Registrations	NSA, Units	m	pc1	20	45	Hard Data
FR	Gross Domestic Product	SWDA Mil.Chn.2014.Euros	q	pca	30	89	Hard Data
FR	Registered Unemployed: Act. Seeking, Not Working	SWDA, EOP, Thous	m	pch	25	37	Hard Data
FR	New Passenger Car Registrations	NSA, Units	m	pc1	5	90	Hard Data
FR	Industrial Production: Manufacturing	SA/WDA, 2005=100	m	pch	40	60	Hard Data
FR	Industrial Production: Construction	SA/WDA, 2005=100	m	pch	45	60	Hard Data
FR	HH Consumption Exp: Total Manufactured Goods	SA/WDA, Bil.chn.2005.Euros	m	pch	30	17	Hard Data
FR	Business Survey: Order Books & Demand, Manuf.	SA, % Balance	m	lin	-7	11	Soft Data
FR	Turnover: Manufacturing	SWDA, 2005=100	m	pch	60	11	Hard Data
FR	PMI: Manufacturing Flash	SA, 50+=Expansion	m	lin	-7	97	Soft Data
FR	PMI: Services Flash	SA, 50+=Expansion	m	lin	-7	77	Soft Data
FR	Retail Sales Vol. excl Motor Vehic. & Motorcyc.	SWDA, 2005=100	m	pch	60	55	Hard Data
FR	Household Survey: Overall Household Conf. Ind.	SA, LT Avg=100	m	lin	-5	80	Soft Data
FR	BdF Mo Bus Survey: Business Sentiment Indicator	SA, Long-term Avg=100	m	lin	-6	51	Soft Data
FR	Composite Business Climate Indicator	NSA, LT Avg=100	m	lin	-7	11	Soft Data
FR	Total Imports including Military Equipment	SA, Mil.Euros	m	pch	65	54	Hard Data
FR	Total Exports including Military Equipment	SA, Mil.Euros	m	pch	65	51	Hard Data
GE	Gross Domestic Product	SWDA Bil.Chn.2015.Euros	q	pca	45	80	Hard Data
GE	Registered Civilian Unemployment Rate	SA, %	m	lin	0	68	Hard Data
GE	Job Vacancies [Unsubsidized]	SA, Thous	m	pch	0	68	Hard Data
GE	Industrial Production including Construction	SA/WDA, 2005=100	m	pch	38	92	Hard Data
GE	Industrial Production: Construction	SA/WDA, 2005=100	m	pch	38	92	Hard Data
GE	Manufacturing Orders [Volume]	SA/WDA, 2005=100	m	pch	35	91	Soft Data
GE	Industry Sales [Volume]: Manufacturing	SA/WDA, 2005=100	m	pch	35	91	Hard Data
GE	New Passenr Car Registrations	NSA, Number	m	pc1	15	48	Hard Data
GE	PMI: Manufacturing Flash	SA, 50+=Expansion	m	lin	-7	90	Soft Data
GE	PMI: Services Flash	SA, 50+=Expansion	m	lin	-7	73	Soft Data
GE	Retail Sales Volume excluding Motor Vehicles	SWDA, 2005=100	m	pch	30	62	Hard Data
GE	Ifo Business Climate Index: All Sectors	SA, 2005=100	m	lin	-7	98	Soft Data
GE	GfK Consumer Climate	SA, %	m	lin	-30	92	Soft Data
GE	Exports of Goods	SA, Bil.Euros	m	pch	40	98	Hard Data
GE	Imports of Goods	SA, Bil.Euros	m	pch	40	44	Hard Data
IT	Gross Domestic Product	SA/WDA, Mil.Chn.2010.EUR	q	pca	30	86	Hard Data
IT	Harmonized Unemployment Rate	SA, %	m	lin	30	56	Hard Data
IT	Production in Construction	SA, 2005=100	m	pch	48	97	Hard Data
IT	IP: Total Industry excl Construction	SA/WDA, 2005=100	m	pch	40	94	Hard Data
IT	Manufacturing Orders	SA, 2005=100	m	pch	47	62	Soft Data
IT	Industrial Turnover	SA, 2005=100	m	pch	50	62	Hard Data
IT	Passenger Car Registrations	NSA, Units	m	pc1	3	37	Hard Data
IT	PMI: Manufacturing	SA, 50+=Expansion	m	lin	3	90	Soft Data
IT	PMI: Services: Business Activity	SA, 50+=Expansion	m	lin	3	70	Soft Data
IT	Retail Sales Excl Motor Vehicles & Motorcyc. Value	SA, 2005=100	m	pch	35	72	Hard Data
IT	ISAE Consumer Confidence Indicator	SA, 1980=100	m	lin	-5	90	Soft Data
IT	ISAE Business Confidence Indicator	SA, 2005=100	m	lin	-5	55	Soft Data
IT	Merchandise Exports, fob	SA, Mil.Euros	m	pch	45	93	Hard Data
IT	Merchandise Imports, cif	SA, Mil.Euros	m	pch	45	74	Hard Data

Back

Alternative Models and Estimation

General Dynamic Factor Model (DFM):

$$\begin{bmatrix} \mathbf{y_t^{(m)}} \\ \mathbf{y_t^{(q)}} \end{bmatrix} = \begin{bmatrix} \Lambda^{(m)} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \Lambda^{(q)} & 2\Lambda^{(q)} & 3\Lambda^{(q)} & 2\Lambda^{(q)} & \Lambda^{(q)} \end{bmatrix} \begin{bmatrix} \mathbf{f_t} \\ \vdots \\ \mathbf{f_{t-4}} \end{bmatrix} + \begin{bmatrix} \mathbf{e_t^{(m)}} \\ \mathbf{e_t^{(q)}} \end{bmatrix}$$

$$\mathbf{f_t} \sim \text{VAR(p)} \qquad \mathbf{e_t^{(m)}}, \mathbf{e_t^{(q)}} \sim \text{AR(1)}$$

AR(1): separately for c = ea, ge, fr, it

Individual DFM's: $f_t^c \sim$ AR(1) and $\mathbf{y_t^c}$, separately for c = ea, ge, fr, it

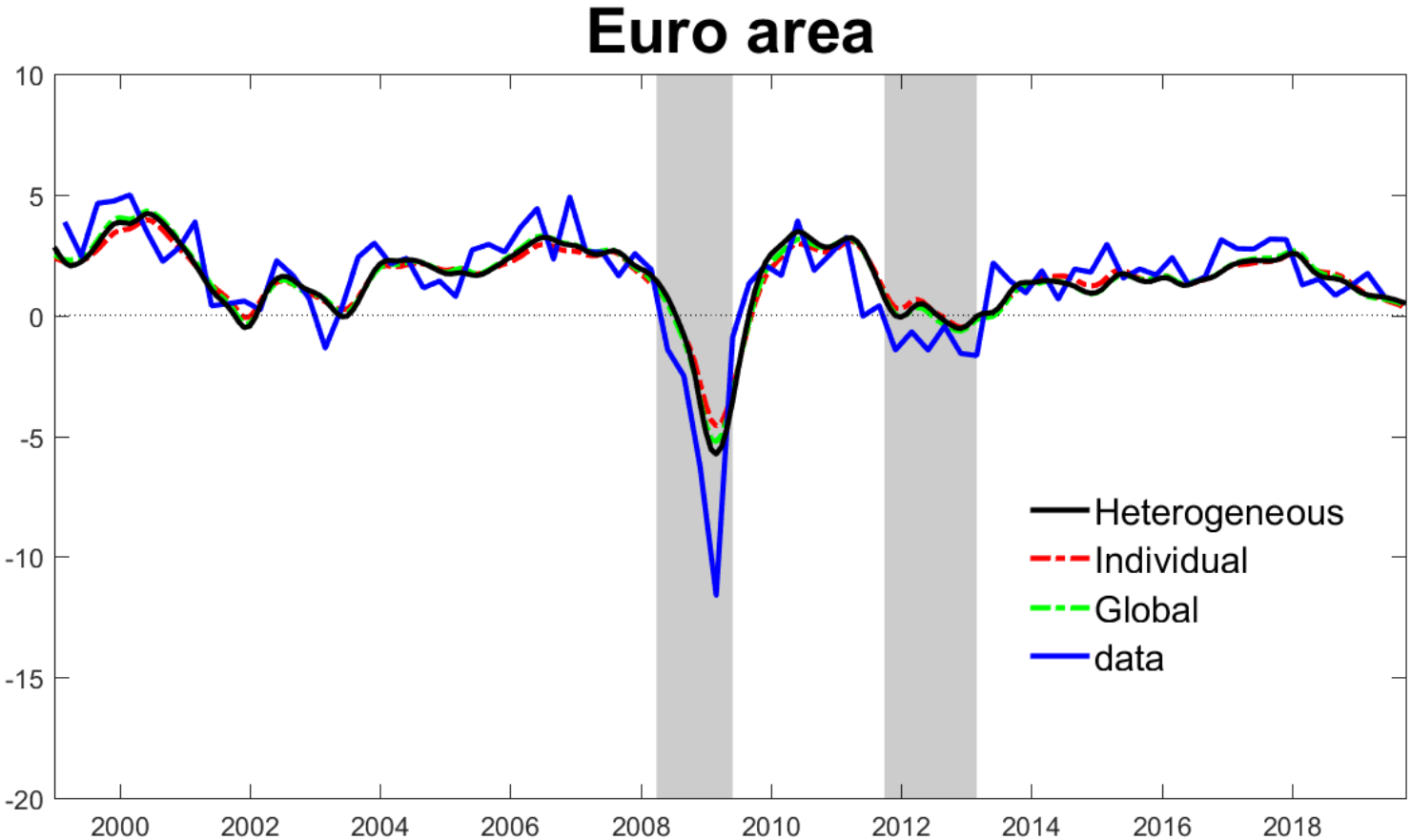
Global DFM: $f_t \sim$ AR(1) and $\mathbf{y_t}$, on full dataset

Estimation:

- Maximum likelihood
- EM-algorithm of Banbura and Modugno (2014)

In-sample Performance of Different Models

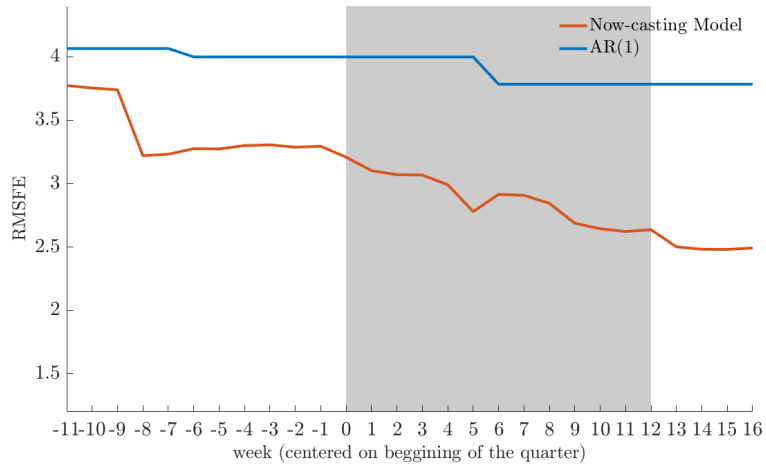
Three models seem to track the data reasonably well



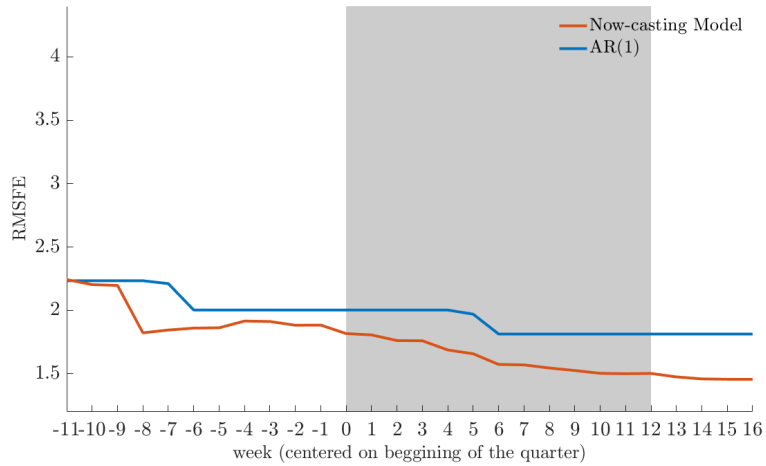
Note: Shaded areas are euro area recession periods as dated by the Center for Economic and Policy Research (CEPR).

- Including: early-2000's, GFC, and 2011-13

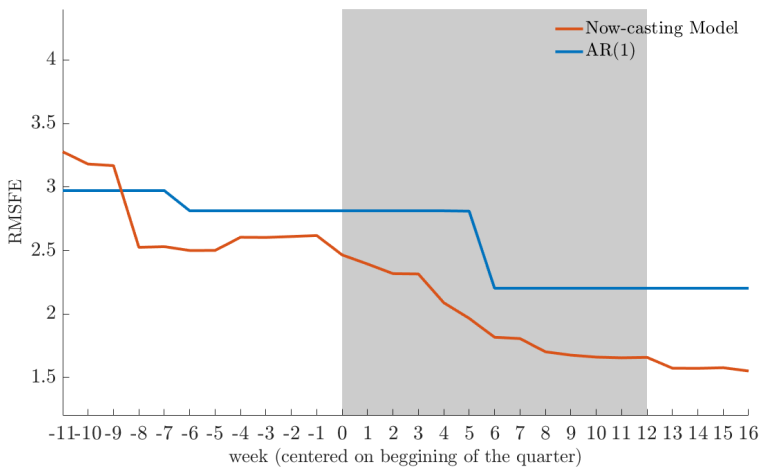
Modeling Economies Together Improves the Now-cast



(c) Germany

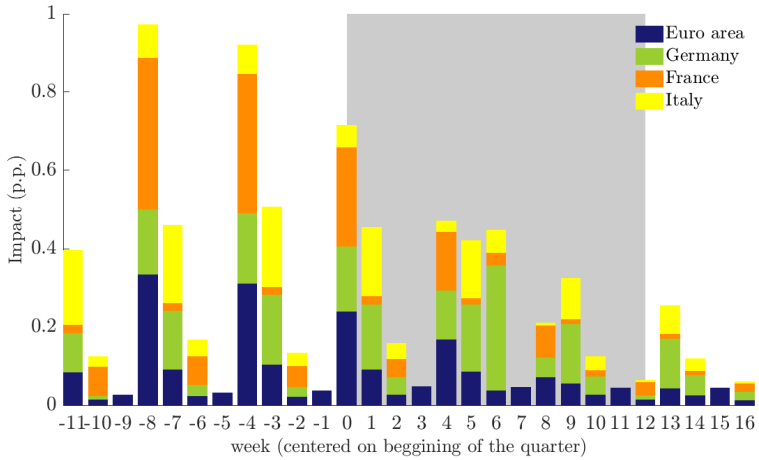


(d) France

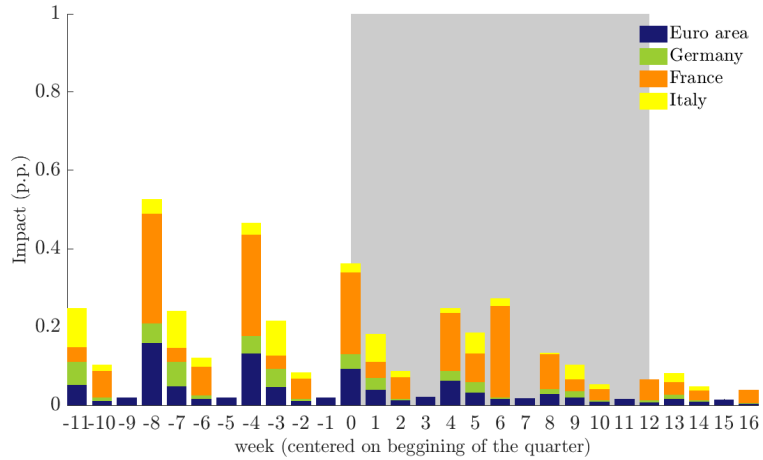


(e) Italy

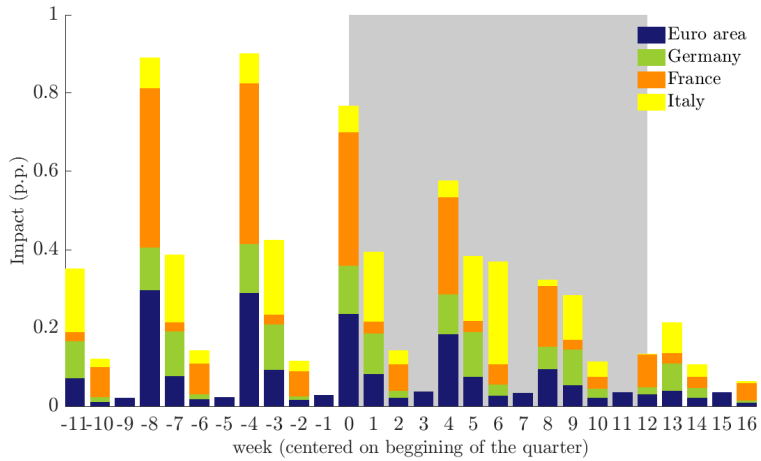
EA Data Matters to Now-cast Countries' GDP



(a) Germany

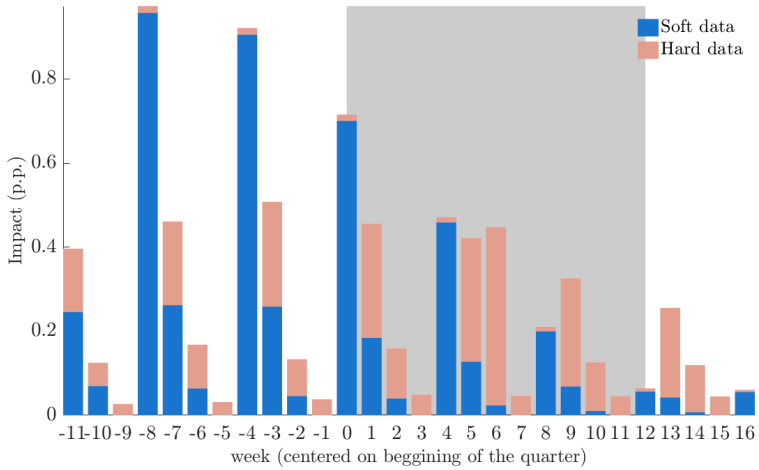


(b) France

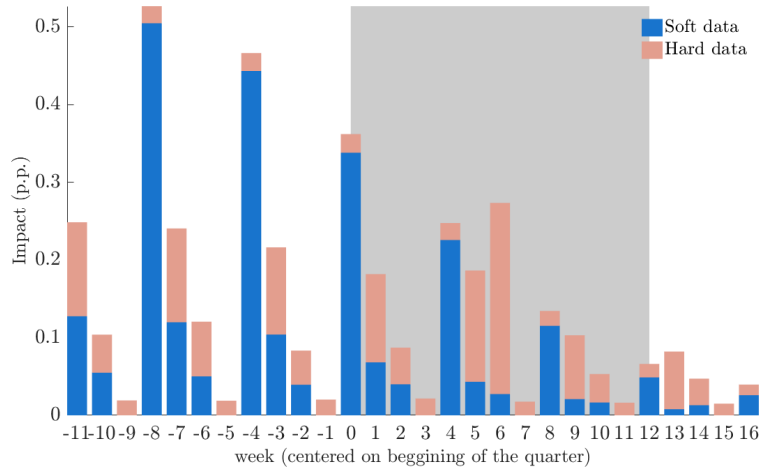


(c) Italy

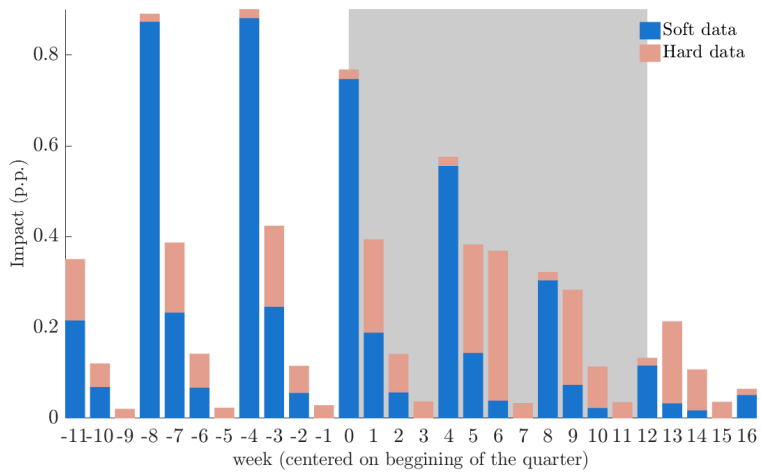
Soft Data is Important for Now-casting EA GDP



(a) Germany



(b) France

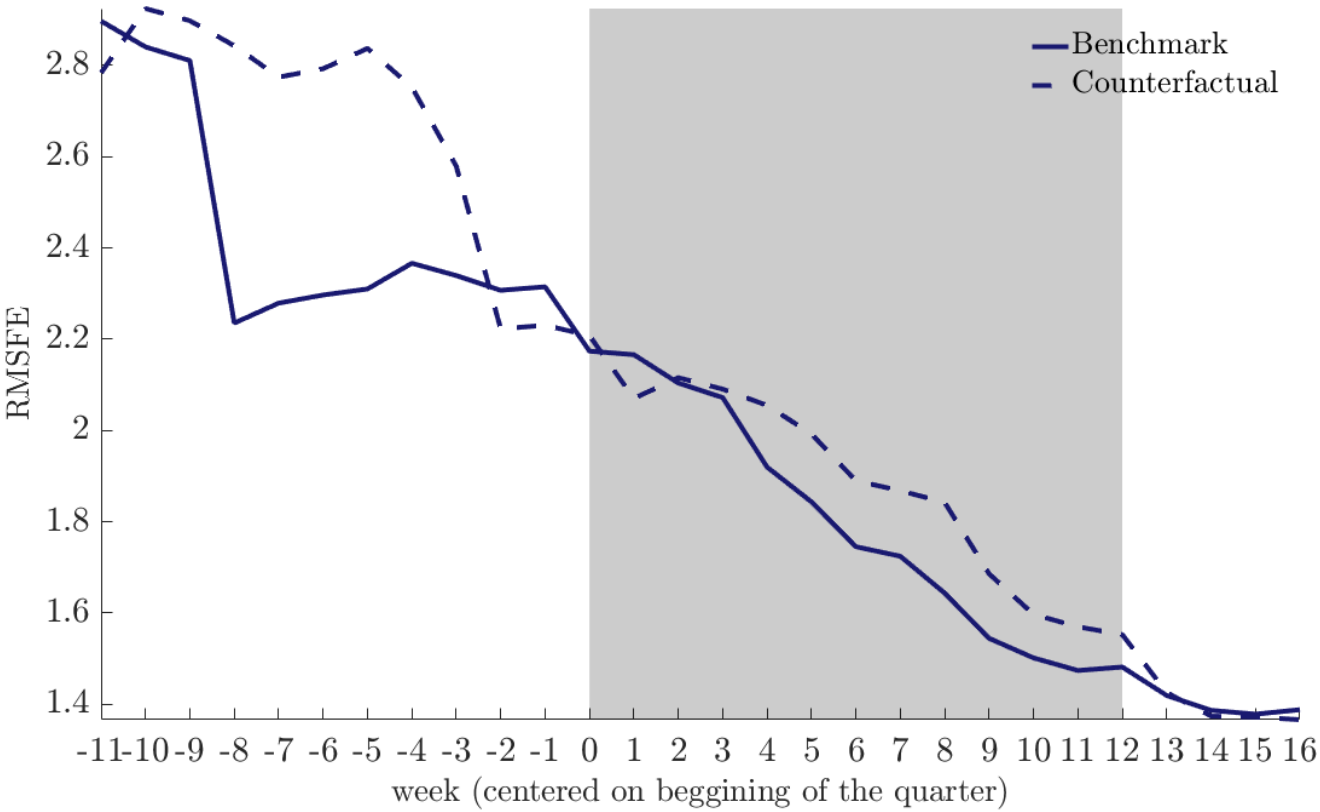


(c) Italy

Soft Data is Important for Now-casting EA GDP

Counterfactual dataset: soft data released jointly with countries/aggregate IP

Pseudo-out-of-sample RMSFEs: EA

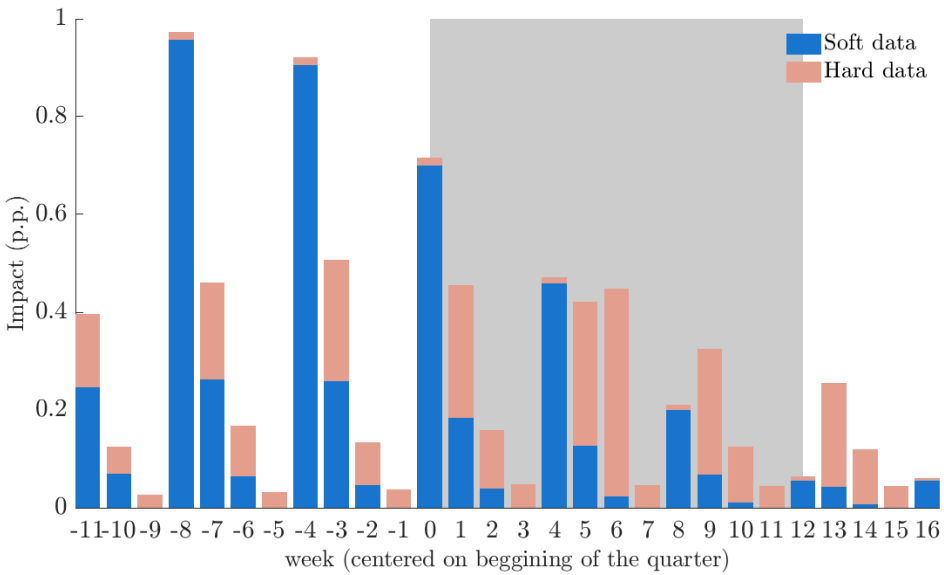


Note: Shaded area represents now-cast periods (current quarter forecast).

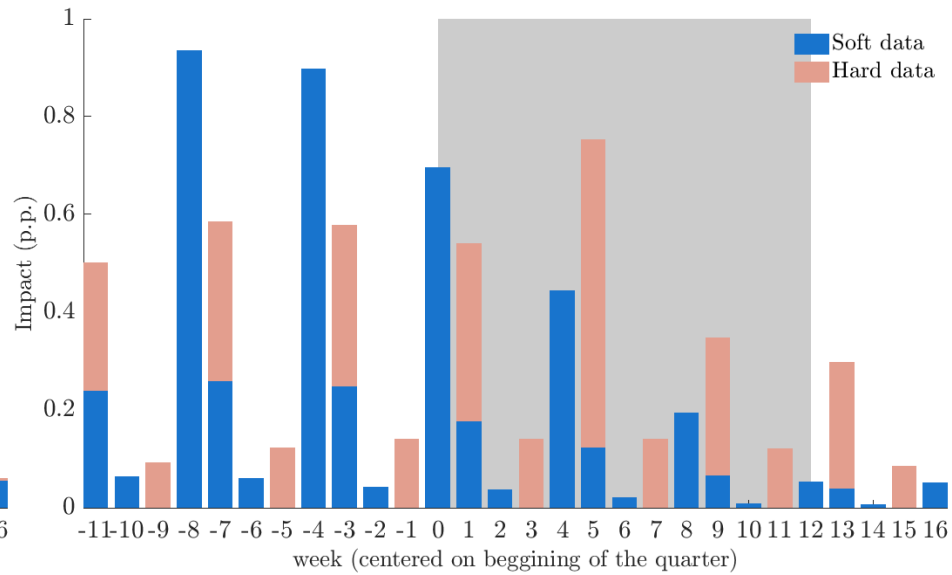
- Benchmark better in...
  ...weeks -8 through -4
- Soft data advancing important info to forecast

Soft Data is Important for Now-casting EA GDP

Counterfactual dataset: hard data releases anticipated to match U.S. schedule



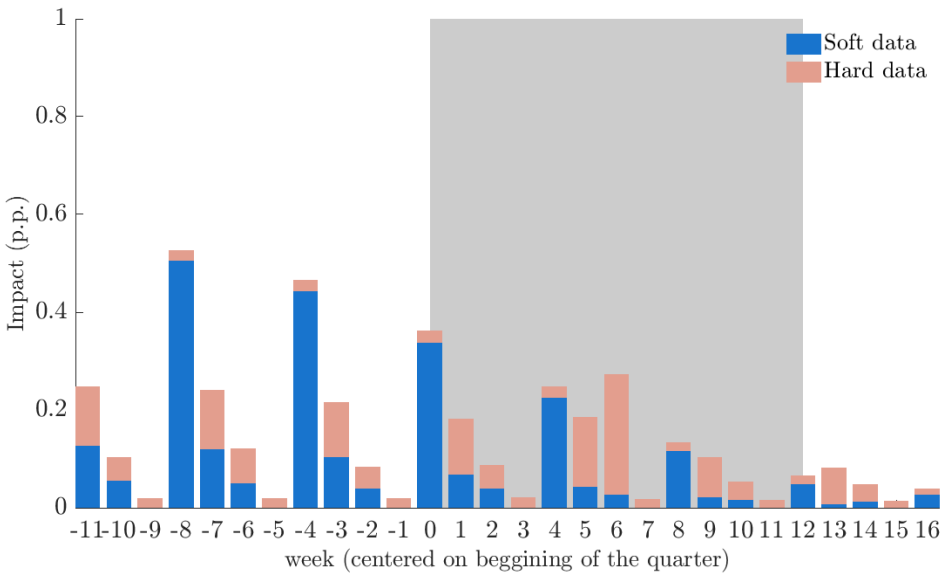
(a) Germany Baseline



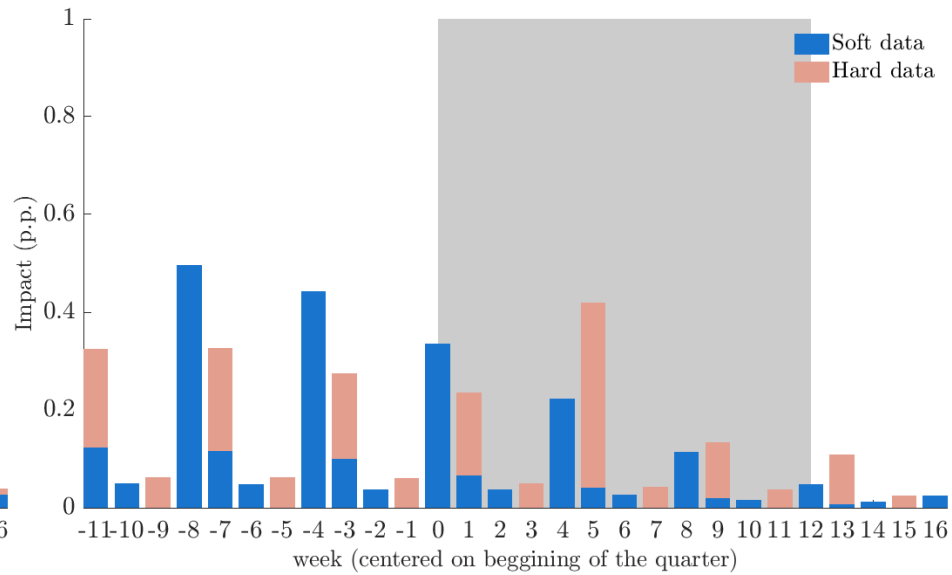
(b) Germany Counterfactual

Soft Data is Important for Now-casting EA GDP

Counterfactual dataset: hard data releases anticipated to match U.S. schedule



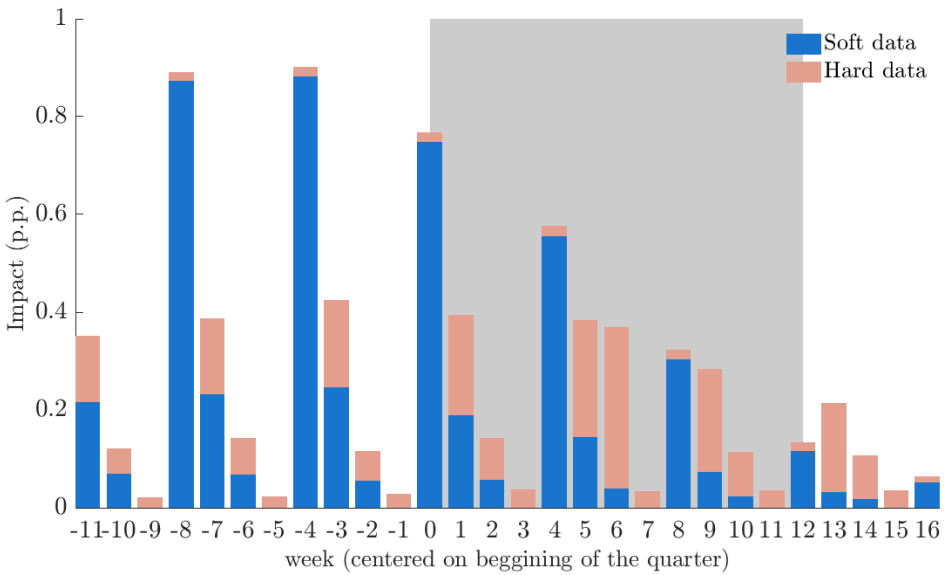
(a) France Baseline



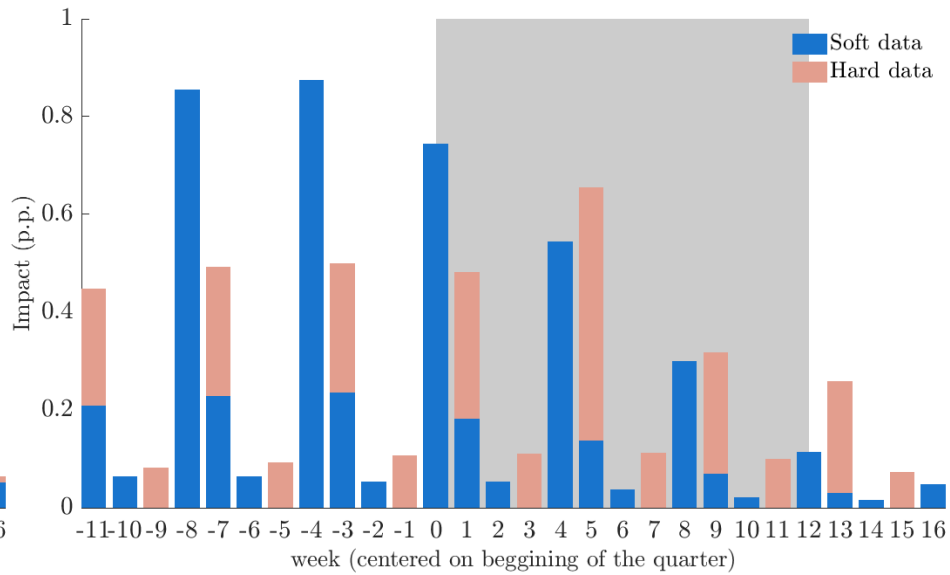
(b) France Counterfactual

Soft Data is Important for Now-casting EA GDP

Counterfactual dataset: hard data releases anticipated to match U.S. schedule

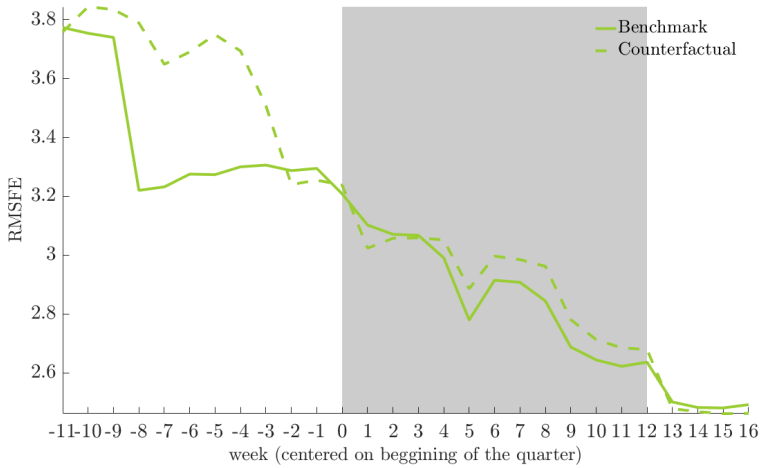


(a) Italy Baseline

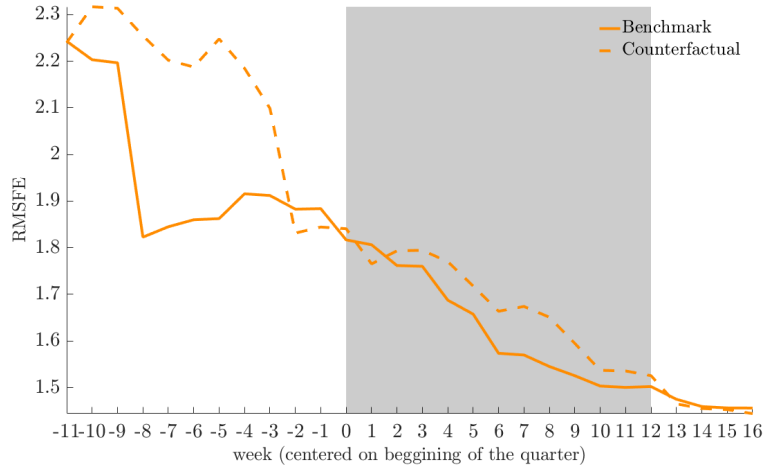


(b) Italy Counterfactual

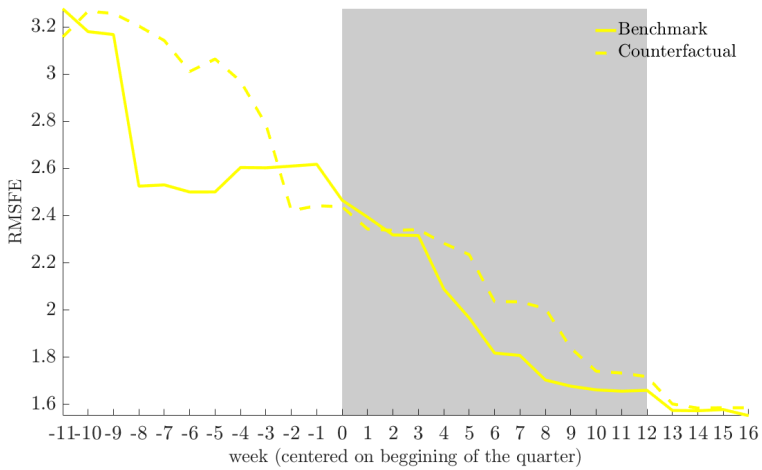
Soft Data is Important for Now-casting EA GDP



(a) Germany



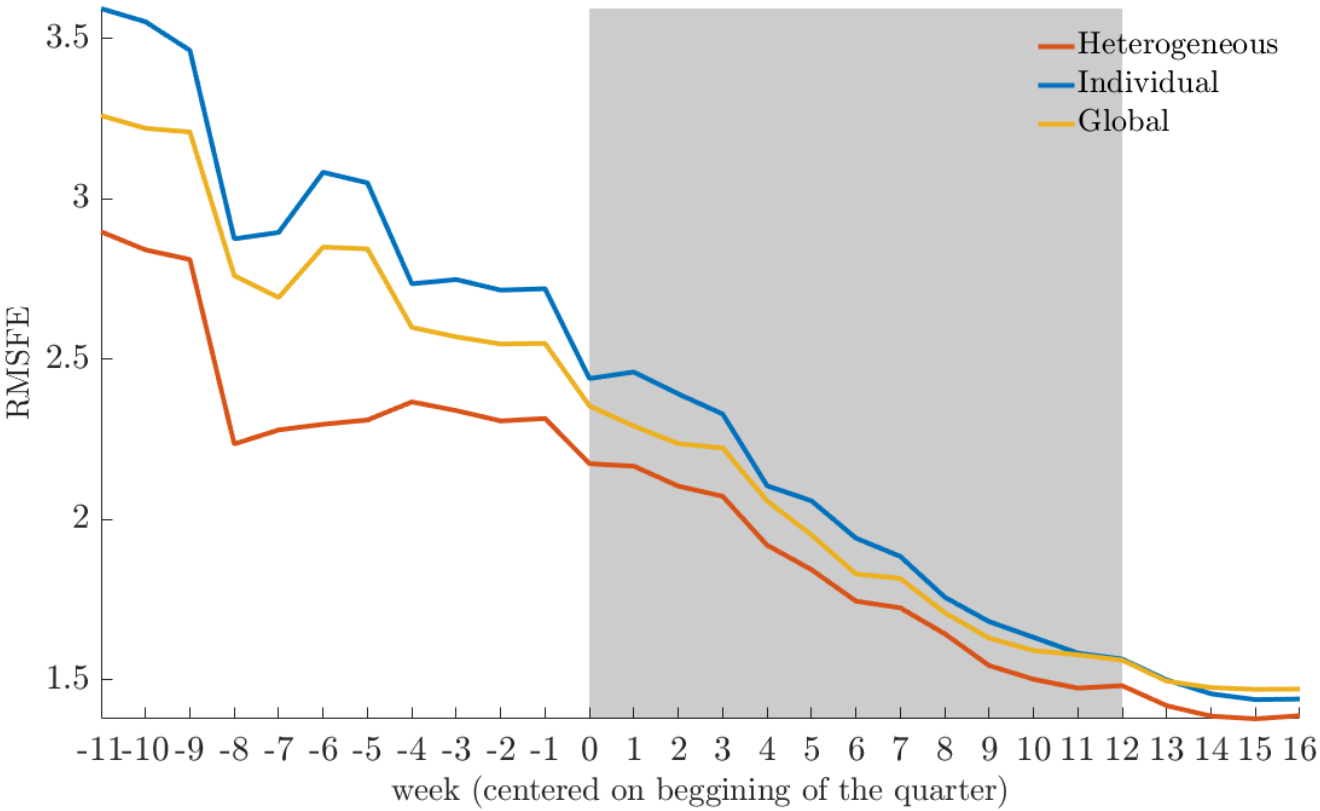
(b) France



(c) Italy

Gains on Modeling Dynamic Heterogeneity

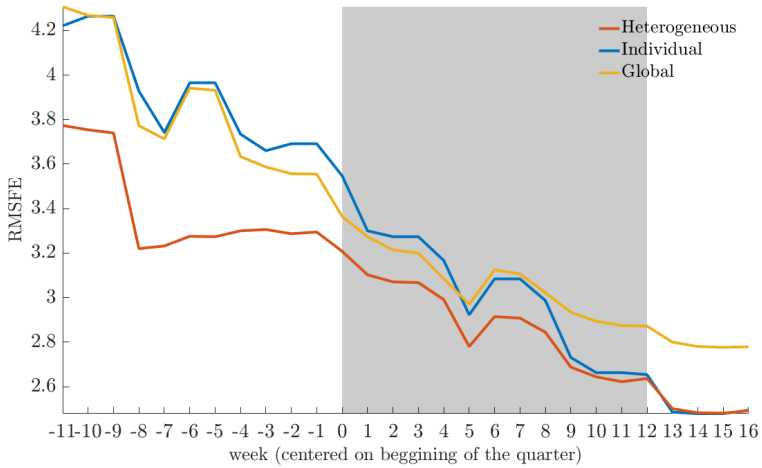
Pseudo-out-of-sample RMSFEs: EA



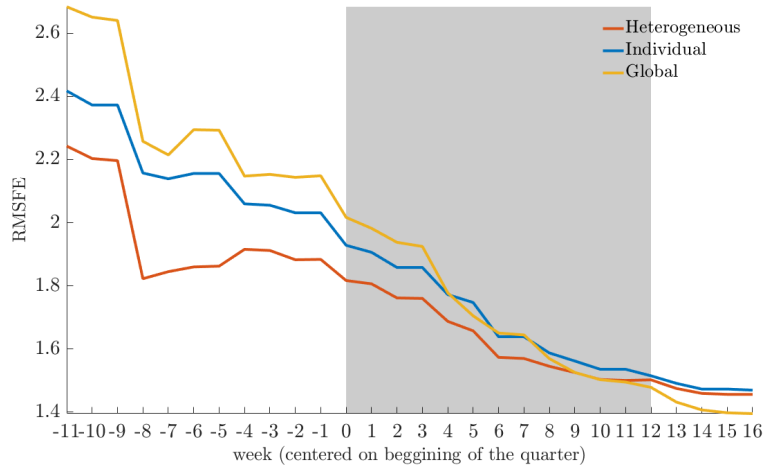
- RMSFEs:
  - decrease over time
  - Hetero<Global<Indiv (consistently over horizons)
- Difference in RMSFEs...
  - ...decreasing → backcast

Note: Shaded area represents now-cast periods (current quarter forecast).

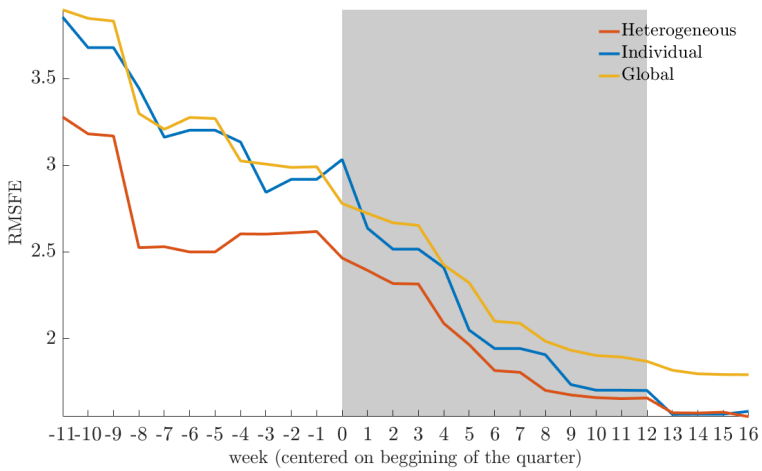
Gains on Modeling Dynamic Heterogeneity



(a) Germany



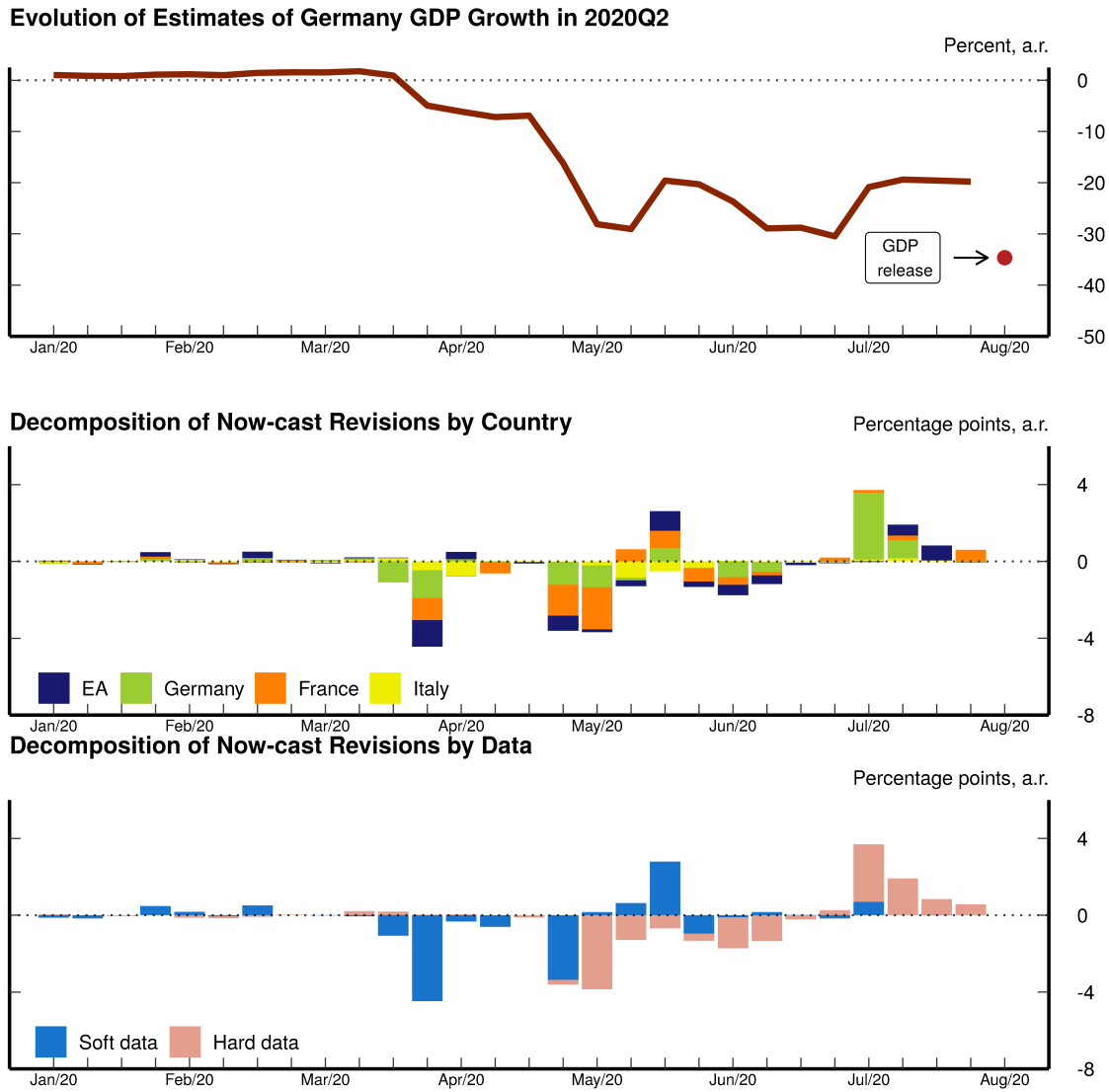
(b) France



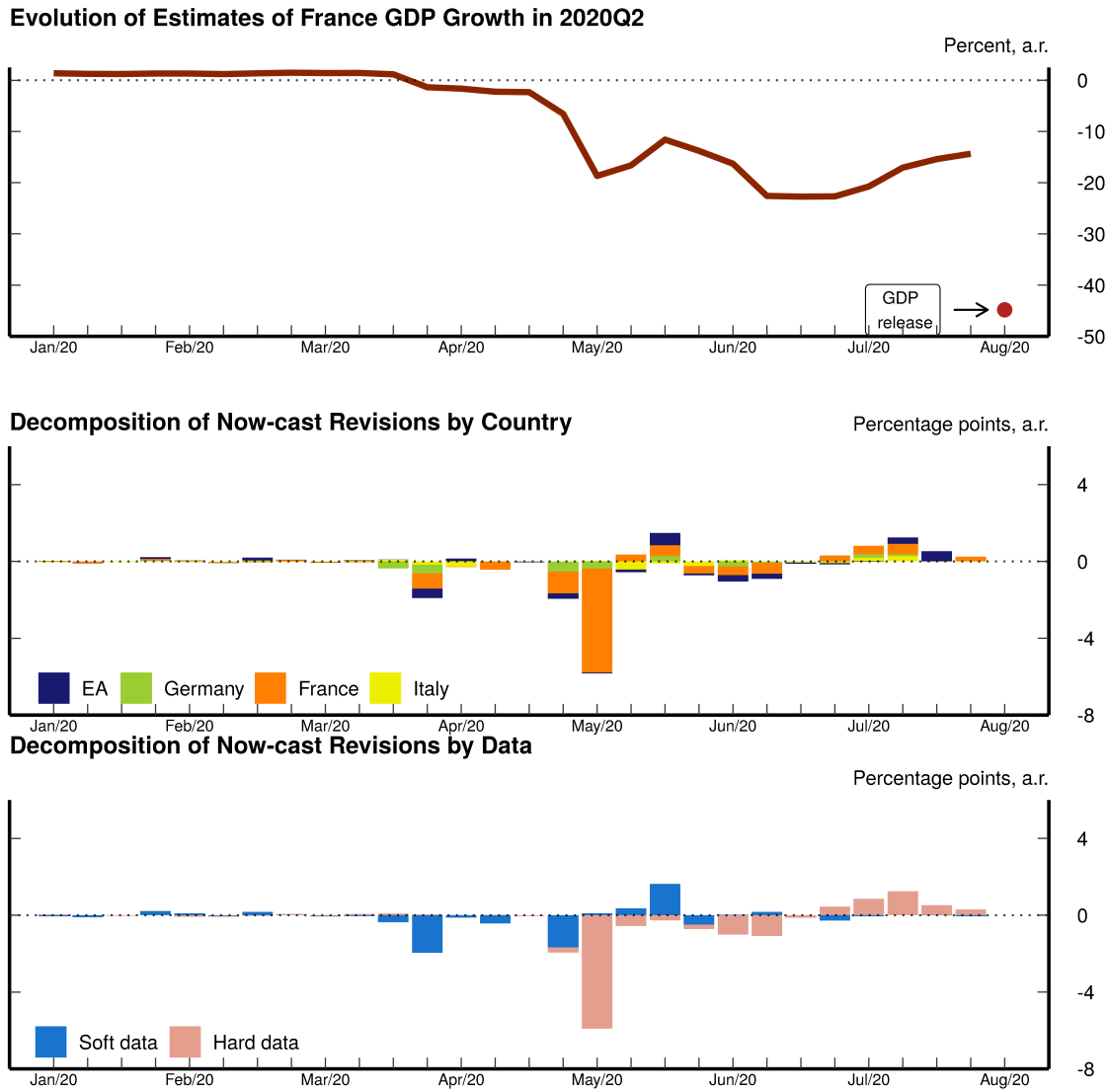
(c) Italy

COVID-19

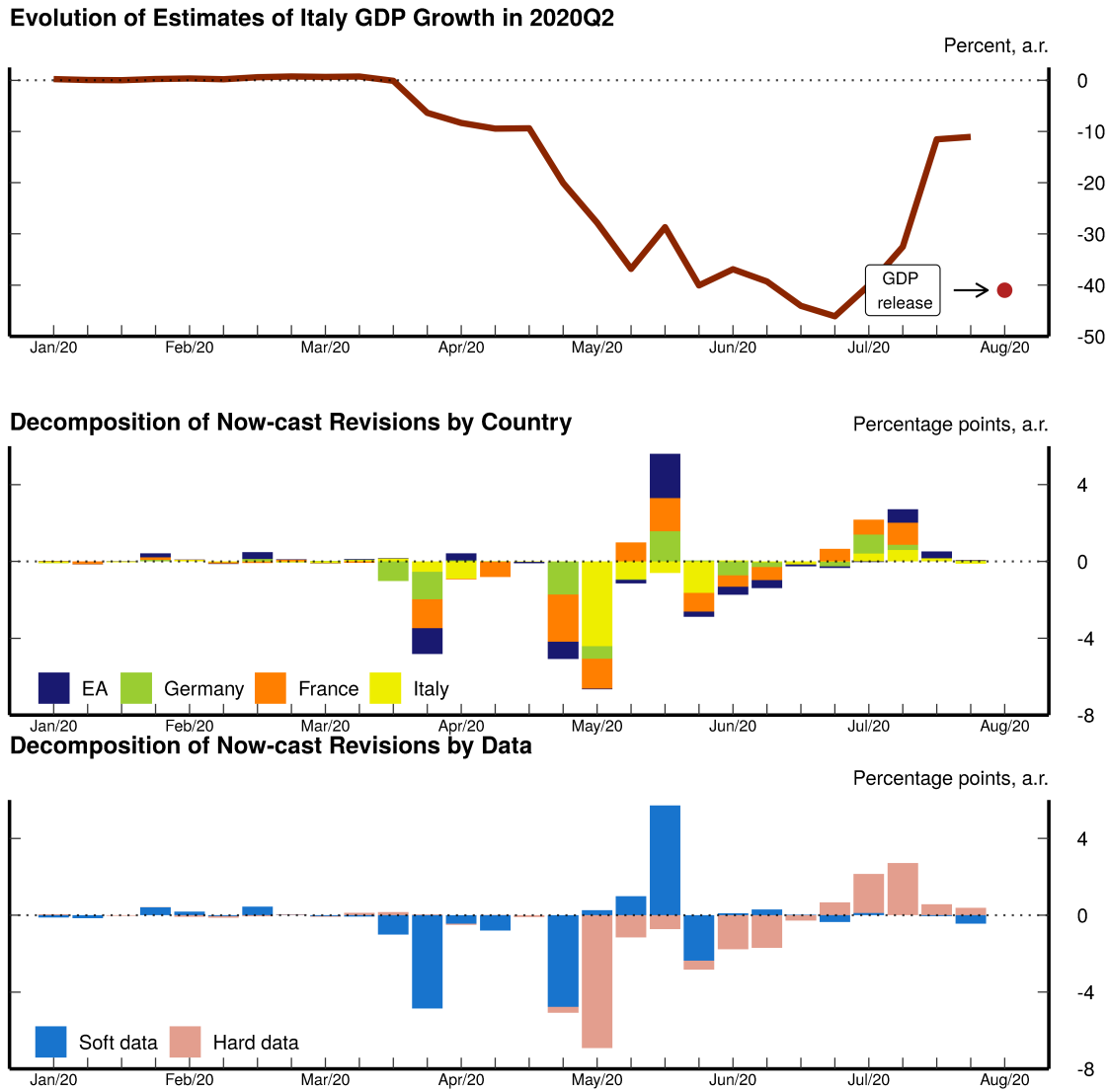
Sudden Stop in Activity due to COVID-19 - Germany



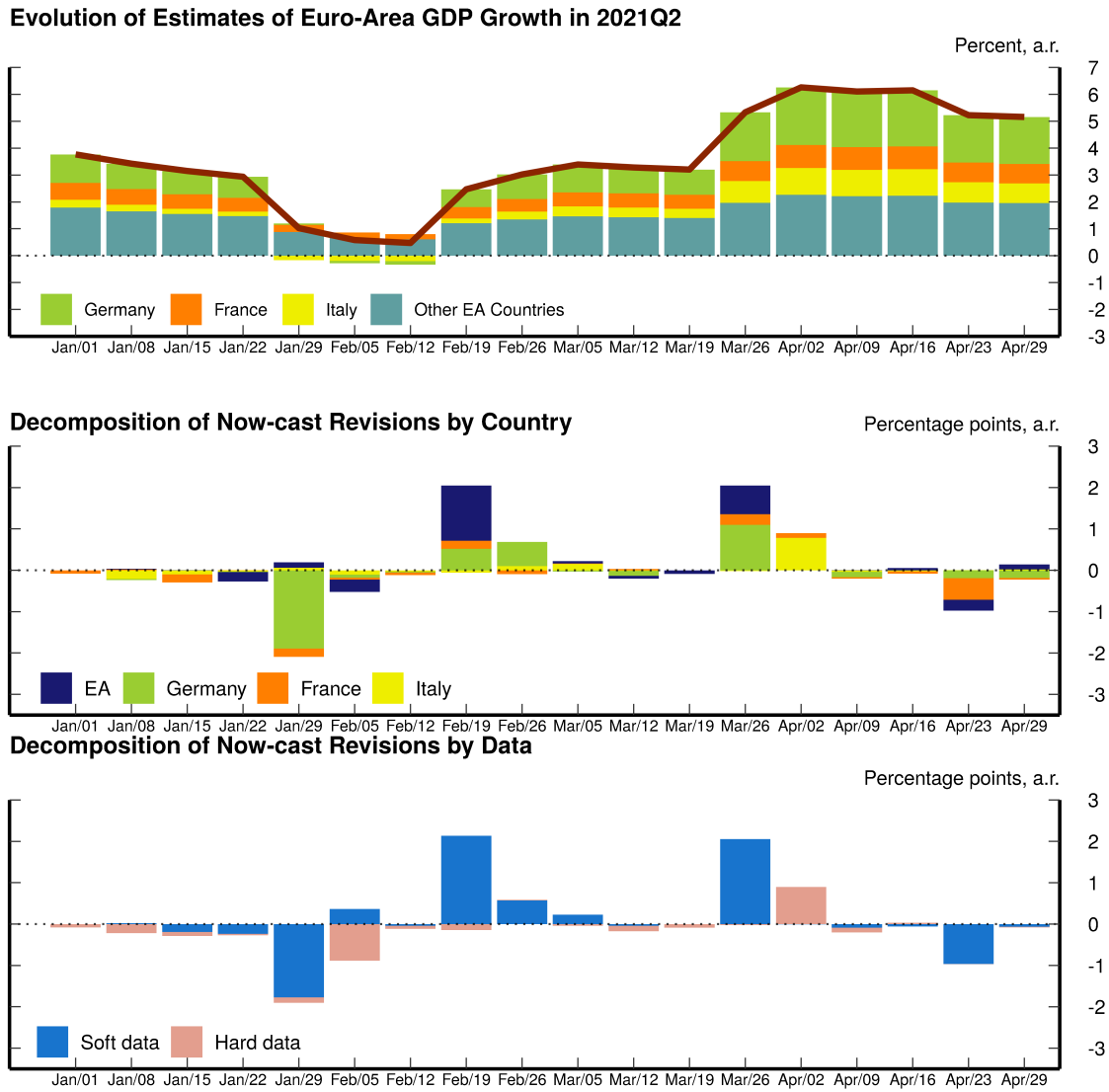
Sudden Stop in Activity due to COVID-19 - France



Sudden Stop in Activity due to COVID-19 - Italy



2021:Q2 forecast



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