Panel discussion: Opportunities and risks using Big Data and machine learning

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Modelling with Big Data and Machine Learning

Bank of England

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The views expressed herein are solely those of the authors and do not necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System.

Monitoring Economic Conditions: It's a big data problem

- **Data Exploration:** Burns and Mitchel 1940s
  - Learning Business Cycles:
    - "Only by analyzing numerous time series, each of restricted significance, can business cycles be made to reveal themselves definitely enough to permit close observation." (*Measuring Business Cycles*, 1946)

- **Statistical Measurement:** Kuznets, 1930s
  - National Accounts and GDP:
    - One of the Great Inventions of the 20th century
    - "Without measures of economic aggregates like GDP, policymakers would be adrift in a sea of unorganized data." (Nordhaus and Samuelson in the 15th edition of their textbook, *Economics*.)

Monitoring Economic Conditions

- **Forecasting with Judgment and Models**
  - NBER-ASSA Survey of Professional Forecasters, Blue Chip…

- **Nowcasting (Machine Learning)**
  - **Model-based** counterpart to conjunctural analysis

"The current suite of tools for handling large series and complicated data flows […] using a single model to evaluate these releases rather than a suite of small models or judgment, provides a scientific way to use the real-time data flow." (Stock and Watson, *Twenty Years of Time Series Econometrics in Ten Pictures,* p.71, 2017)

Monitoring Economic Conditions

At the forefront of the big data revolution.

“I stumbled on the term Big Data innocently enough, via discussion of two papers that took a new approach to macro-econometric dynamic factor models (DFMs) […] in an invited session of the 2000 World Congress of the Econometric Society.” (Diebold, The Origin(s) and Development of “Big Data”, p.2, 2018)

The Real-Time Data Flow

The Real-Time Data Flow

1) Calendars 2) Alerts 3) Export 4) Settings Economic Calendars

United States 6) Browse 18:11:02 10/31/18 - 11/07/18

Economic Releases All Economic Releases View Agenda Weekly

	Date Time	A	M	R	Event	Period	Surv(M)	Actual	Prior	Revised	S	Flag
21)	10/31 07:00				MBA Mortgage Applications	Oct 26	--	-2.5%	4.9%	--	92.31	
22)	10/31 08:15				ADP Employment Change	Oct	187k	227k	230k	218k	86.72	
23)	10/31 08:30				Employment Cost Index	3Q	0.7%	0.8%	0.6%	--	75.78	
24)	10/31 09:45				Chicago Purchasing Manager	Oct	60.0	58.4	60.4	--	82.03	
25)	11/01 07:30				Challenger Job Cuts YoY	Oct	--	--	70.9%	--	35.94	
26)	11/01 08:30				Nonfarm Productivity	3Q P	2.1%	--	2.9%	--	42.97	
27)	11/01 08:30				Unit Labor Costs	3Q P	1.0%	--	-1.0%	--	38.28	
28)	11/01 08:30				Initial Jobless Claims	Oct 27	212k	--	215k	--	98.44	
29)	11/01 08:30				Continuing Claims	Oct 20	1640k	--	1636k	--	68.91	
30)	11/01 09:45				Bloomberg Consumer Comf...	Oct 28	--	--	60.1	--	67.97	
31)	11/01 09:45				Markit US Manufacturing PMI	Oct F	55.8	--	55.9	--	90.00	
32)	11/01 10:00				Construction Spending MoM	Sep	0.0%	--	0.1%	--	80.47	
33)	11/01 10:00				ISM Manufacturing	Oct	59.0	--	59.8	--	95.31	
34)	11/01 10:00				ISM Employment	Oct	--	--	58.8	--	3.91	
35)	11/01 10:00				ISM Prices Paid	Oct	69.0	--	66.9	--	73.44	
36)	11/01 10:00				ISM New Orders	Oct	--	--	61.8	--	7.03	
37)	11/01				Wards Total Vehicle Sales	Oct	17.05m	--	17.40m	--	45.31	
38)	11/02 08:30				Trade Balance	Sep	-$53.6b	--	-$53.2	--	84.38	
39)	11/02 08:30				Change in Nonfarm Payrolls	Oct	200k	--	134k	--	99.22	
40)	11/02 08:30				Two-Month Payroll Net Rev...	Oct	--	--	--	--	16.41	
41)	11/02 08:30				Change in Private Payrolls	Oct	195k	--	121k	--	30.47	
42)	11/02 08:30				Change in Manufact. Payrolls	Oct	16k	--	18k	--	69.45	
43)	11/02 08:30				Unemployment Rate	Oct	3.7%	--	3.7%	--	89.30	
44)	11/02 08:30				Underemployment Rate	Oct	--	--	7.5%	--	22.66	
45)	11/02 08:30				Average Hourly Earnings M...	Oct	0.2%	--	0.3%	--	31.25	
46)	11/02 08:30				Average Hourly Earnings YoY	Oct	3.1%	--	2.8%	--	32.03	
47)	11/02 08:30				Average Weekly Hours All ...	Oct	34.5	--	34.5	--	25.78	
48)	11/02 08:30				Labor Force Participation ...	Oct	62.7%	--	62.7%	--	19.53	
49)	11/02 10:00				Factory Orders	Sep	0.5%	--	2.3%	--	85.94	
50)	11/02 10:00				Factory Orders Ex Trans	Sep	--	--	0.1%	--	8.59	
51)	11/02 10:00				Durable Goods Orders	Sep F	--	--	0.8%	--	92.97	
52)	11/02 10:00				Durables Ex Transportation	Sep F	--	--	0.1%	--	74.38	

The Real-Time Data Flow

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World 6) Browse 18:20:18 10/31/18 - 11/07/18

Economic Releases All Economic Releases View Agenda Weekly

	Date Time	A	M	R	Event	Period	Surv(M)	Actual	Prior	Revised	S	Flag
21)	10/31 00:00				Vehicle Production YoY	Aug	--	-0.3%	-2.0%	-2.0%	42.70	
22)	10/31 01:00				Consumer Confidence Index	Oct	43.5	43.0	43.4	--	19.10	
23)	10/31 01:00				Bloomberg Oct. India Economic Survey (Table)							
24)	10/31 01:00				Housing Starts YoY	Sep	-0.8%	-1.5%	1.6%	--	62.92	
25)	10/31 01:00				Annualized Housing Starts	Sep	0.950m	0.943r	0.957r	--	47.19	
26)	10/31 01:00				Construction Orders YoY	Sep	--	1.0%	0.5%	--	43.82	
27)	10/31 02:00				Industrial Production YoY	Sep	--	2.3%	5.7%	--	64.71	
28)	10/31 03:00				ILO Unemployment Rate	Sep	--	4.1%	4.3%	--	5.26	
29)	10/31 03:00				Retail Sales MoM	Sep	0.5%	0.1%	-0.1%	-0.3%	67.21	
30)	10/31 03:00				Retail Sales YoY	Sep	1.0%	-2.6%	1.6%	1.5%	63.93	
31)	10/31 03:00				Unemployment Rate SA	Sep	3.2%	3.1%	3.2%	--	95.00	
32)	10/31 03:00				Unemployment Rate Gross ...	Sep	3.9%	3.9%	3.9%	--	25.00	
33)	10/31 03:00				Trade Balance	Aug F	--	-419m	-400m	--	70.59	
34)	10/31 03:00				Economic Confidence	Oct	--	67.5	71.0	--	30.30	
35)	10/31 03:00				Trade Balance	Sep	-1.90b	-1.87b	-2.42b	-2.45b	87.88	
36)	10/31 03:30				Central Bank Inflation Report							
37)	10/31 03:30				Exports YoY	Sep	--	-5.5%	5.8%	--	73.08	
38)	10/31 03:30				Exports	Sep	--	$2070	$2238	--	34.62	
39)	10/31 03:30				Imports YoY	Sep	--	14.3%	24.2%	--	50.00	
40)	10/31 03:30				Imports	Sep	--	$1874	$2177	--	23.08	
41)	10/31 03:30				Trade Balance	Sep	--	$1963	$604m	--	57.69	
42)	10/31 03:30				BoP Current Account Balance	Sep	$1180m	$2369	$753m	--	88.46	
43)	10/31 03:30				BoP Overall Balance	Sep	--	$1042	$189m	--	19.23	
44)	10/31 03:45				CPI EU Harmonized MoM	Oct P	0.2%	0.1%	-0.2%	--	65.79	
45)	10/31 03:45				CPI EU Harmonized YoY	Oct P	2.6%	2.5%	2.5%	--	71.05	
46)	10/31 03:45				CPI MoM	Oct P	0.2%	0.1%	-0.2%	--	68.42	
47)	10/31 03:45				CPI YoY	Oct P	2.3%	2.2%	2.2%	--	94.74	
48)	10/31 04:00				GDP YoY	3Q P	2.50%	2.28%	3.30%	--	85.00	
49)	10/31 04:00				GDP QoQ	3Q P	0.6%	0.6%	0.6%	--	79.31	
50)	10/31 04:00				GDP YoY	3Q P	2.5%	2.5%	2.5%	--	72.41	
51)	10/31 04:00				Total Mortgage Lending YoY	Aug	--	10.3%	14.0%	--	27.59	
52)	10/31 04:00				House Mortgage Approvals ...	Aug	--	6.8%	14.6%	--	31.03	

The Real-Time Data Flow

- News moves markets!

GLOBAL MARKETS-Stocks, oil fall, dollar rises after U.S. data

Reuters
Nov. 15, 2017, 11:50 AM 21

US stock futures trade higher after jobs report disappoints

Alexandra Gibbs | @alexgibbsy
Published 6:04 AM ET Fri, 3 Nov 2017 | Updated 8:38 AM ET Fri, 3 Nov 2017

CNBC

#MARKET NEWS NOVEMBER 3, 2017 / 9:14 AM / 15 DAYS AGO

TREASURIES-Yields fall after wages data for October disappoints REUTERS

U.S. Treasury Bond Prices Fall on Strong Data

By Akane Otani | Published October 25, 2017 | Features | Dow Jones Newswires

US Treasury yields climb after stronger industrial production data

Alexandra Gibbs | Thomas Franck
Published 5:45 AM ET Thu, 16 Nov 2017 | Updated 1:50 PM ET Thu, 16 Nov 2017

CNBC

#MARKET NEWS OCTOBER 25, 2017 / 8:48 AM / 23 DAYS AGO

FOREX-Dollar index adds gains on upbeat durable goods data REUTERS

US Treasury yields fall after strong housing starts data

Alexandra Gibbs | @alexgibbsy
Published 12 Hours Ago | Updated 4 Hours Ago

CNBC

U.S. Stocks Rise On Above Expected U.S. GDP Growth

By IFC Markets | (Ara Zohrabian) | Market Overview | Oct 30, 2017 09:41AM ET

The Real-Time Data Flow

Release	Timing	Delay	Source
Construction Spending	first business day of the month, two months prior	33	Census Bureau
ISM Manufacturing Report on Business	first business day of the month, one month prior	3	ISM
ISM Non-Manufacturing Report on Business	third business day of the month, one month prior	5	ISM
U.S. International Trade in Goods and Services	first full week of the month, two months prior	35	BEA, Census Bureau
Manufacturers' Shipments, Inventories, and Orders	first week of the month, two months prior	35	Census Bureau
ADP National Employment Report	first Wednesday of the month, one month prior	5	ADP
Employment Situation	first Friday of the month, one month prior	7	BLS
Manufacturing and Trade Inventories	first full week of the month, two months prior	44	Census Bureau
Job Openings and Labor Turnover	second week of the month, two months prior	42	BLS
U.S. Import and Export Price Indexes	middle of the month, one month prior	13	BLS
Retail Trade	ninth business day of the month, one month prior	14	Census Bureau
Producer Price Index	middle of the month, one month prior	14	BLS
Wholesale Trade	middle of the month, two months prior	37	Census Bureau
Empire State Manufacturing Survey	15th of the month, current month	-14	New York Fed
Manufacturing Business Outlook Survey	third Thursday of the month, current month	-11	Philadelphia Fed
Industrial Production and Capacity Utilization	middle of the month, one month prior	17	Federal Reserve Board
Consumer Price Index	middle of the month, one month prior	18	BLS
New Residential Construction	12th business day of the month, one month prior	16	Census Bureau
Advance Economic Indicators	last week of the month, one month prior	28	Census Bureau
New Residential Sales	17th business day of the month, one month prior	26	Census Bureau
Advance Durable Goods	third week of the month, one month prior	26	Census Bureau
Personal Income and Outlays	last week of the month, one month prior	30	BEA
Gross Domestic Product	last week of the month, prior quarter	28	BEA
Productivity and Costs	first week of the month, prior quarter	34	BLS

Big Data for Monitoring Macroeconomic Conditions

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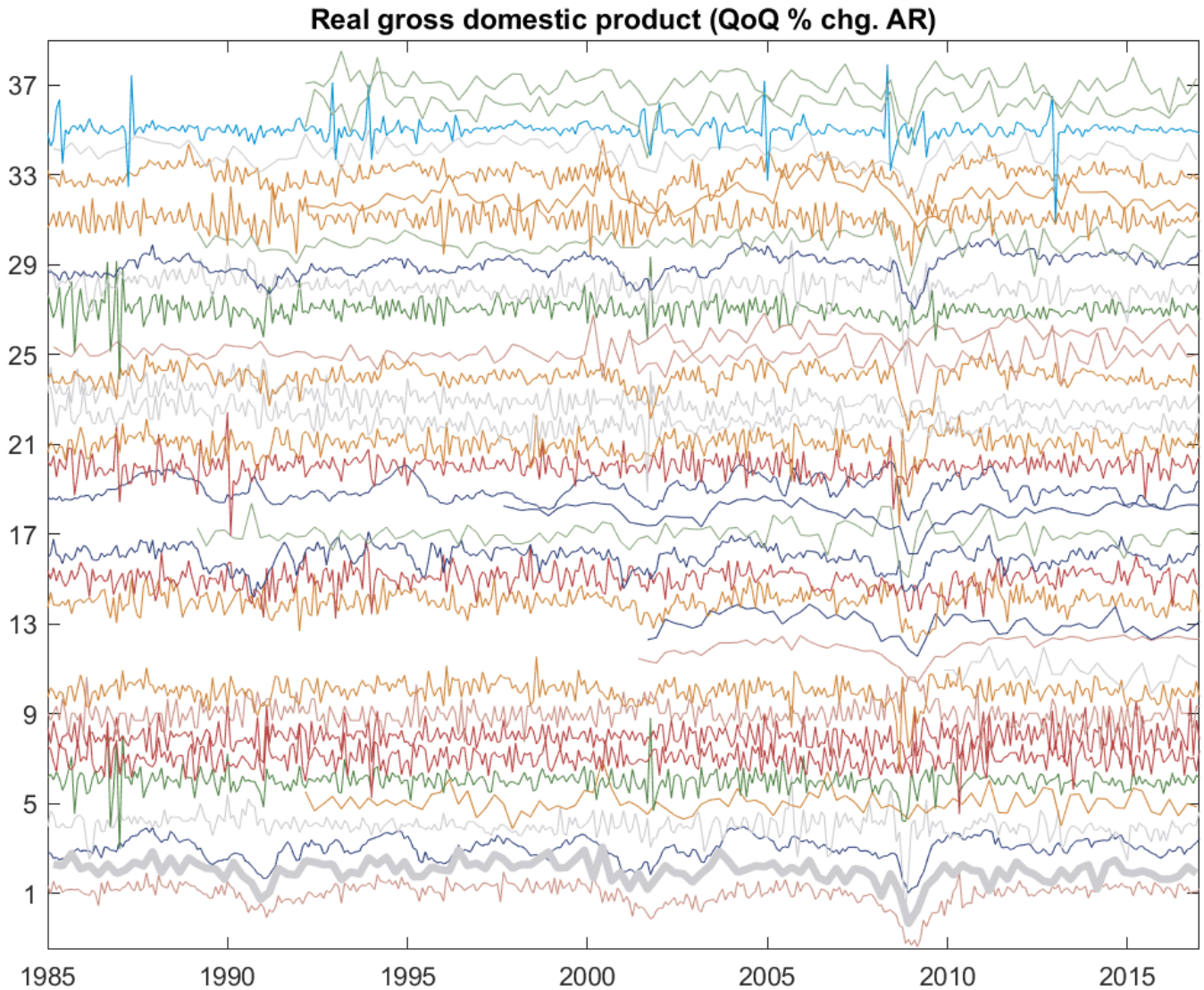

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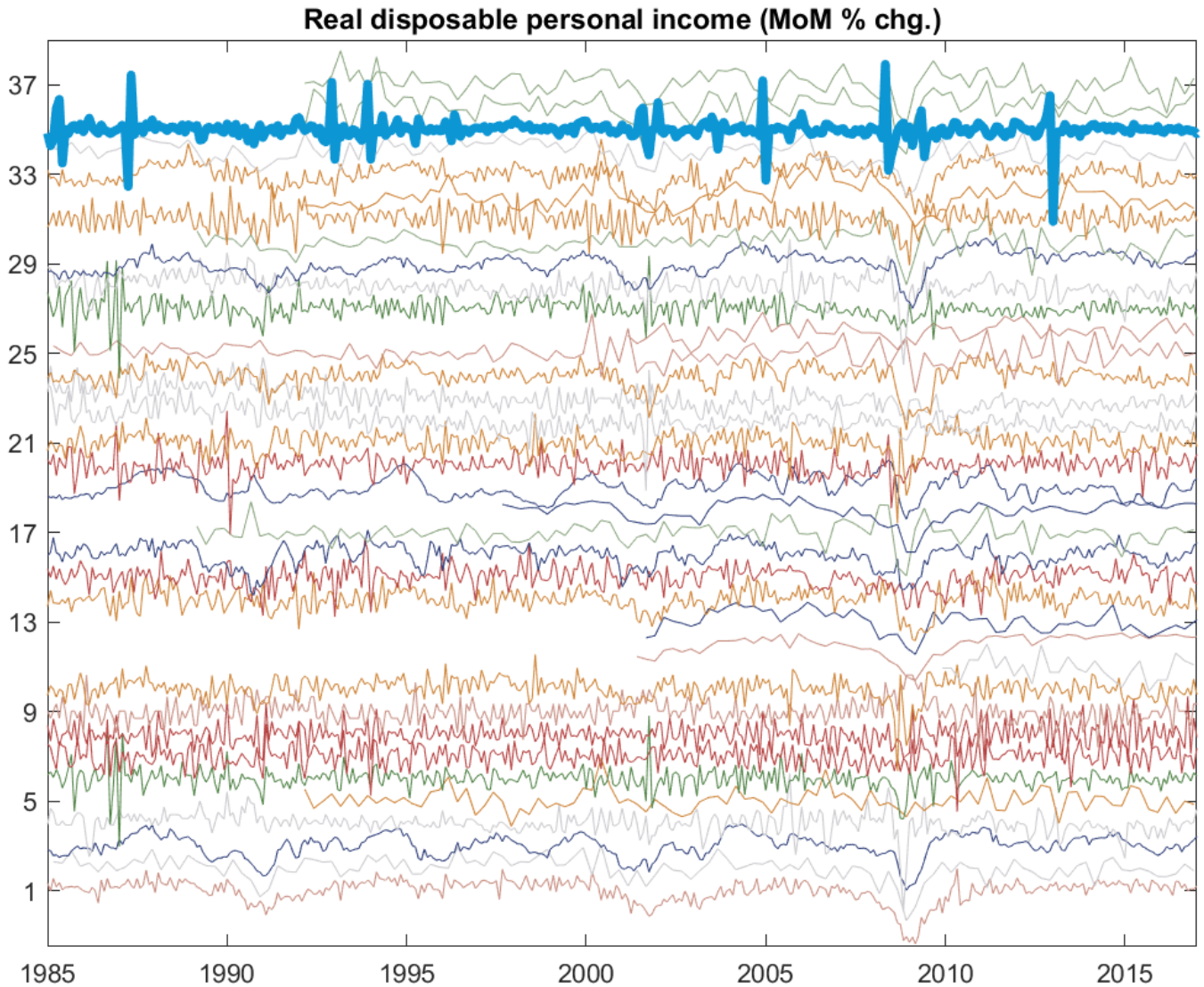

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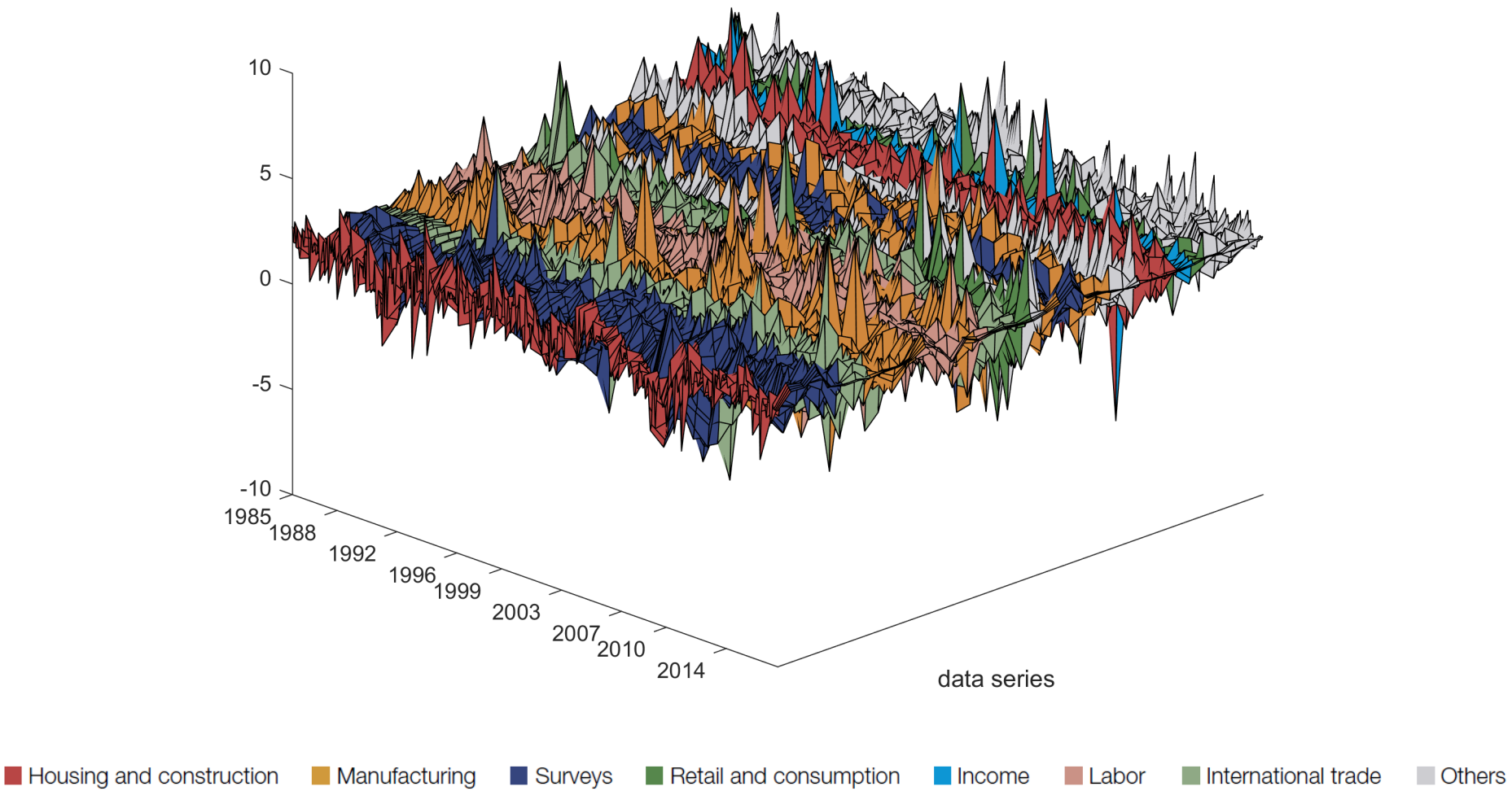

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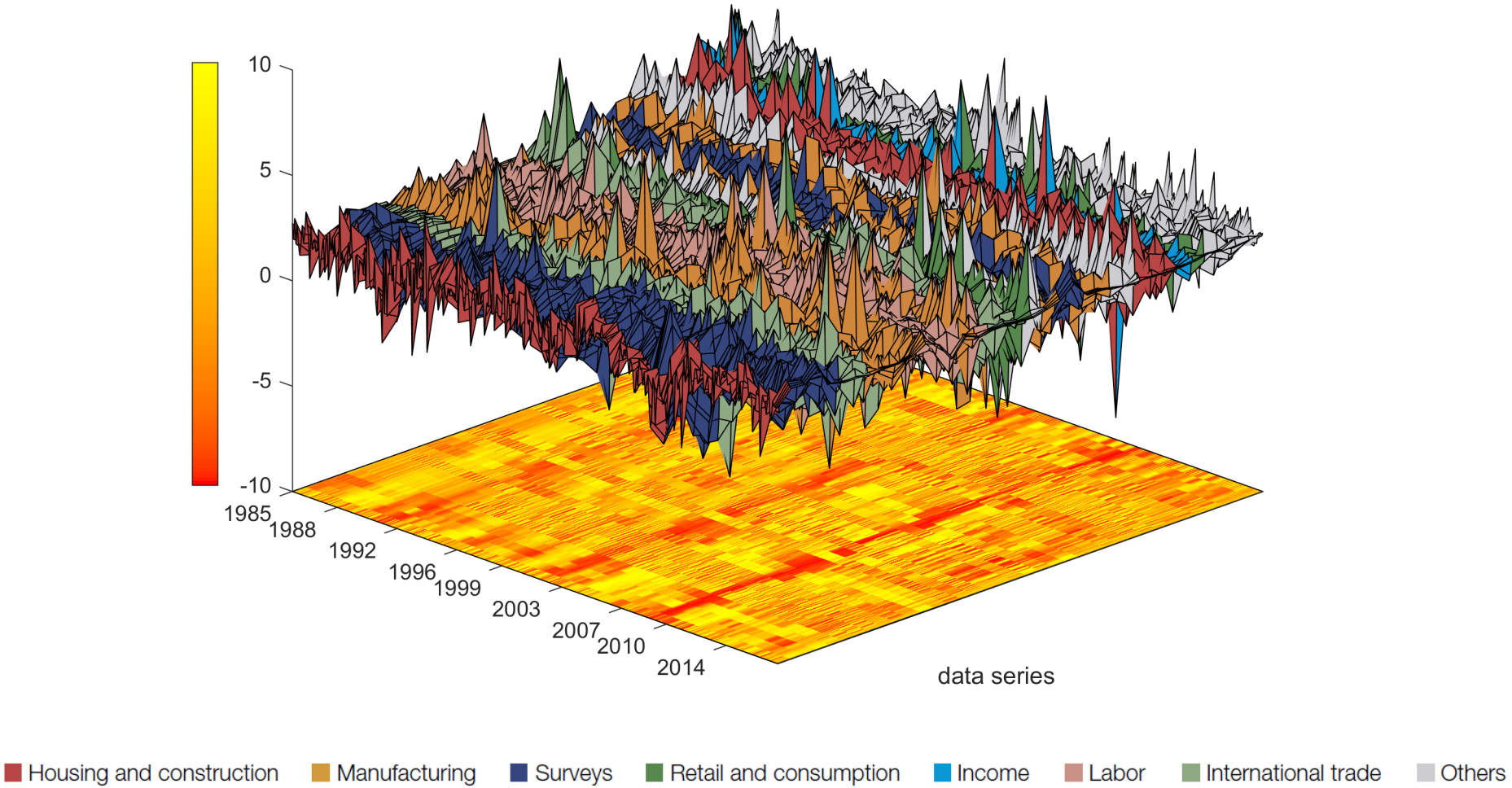

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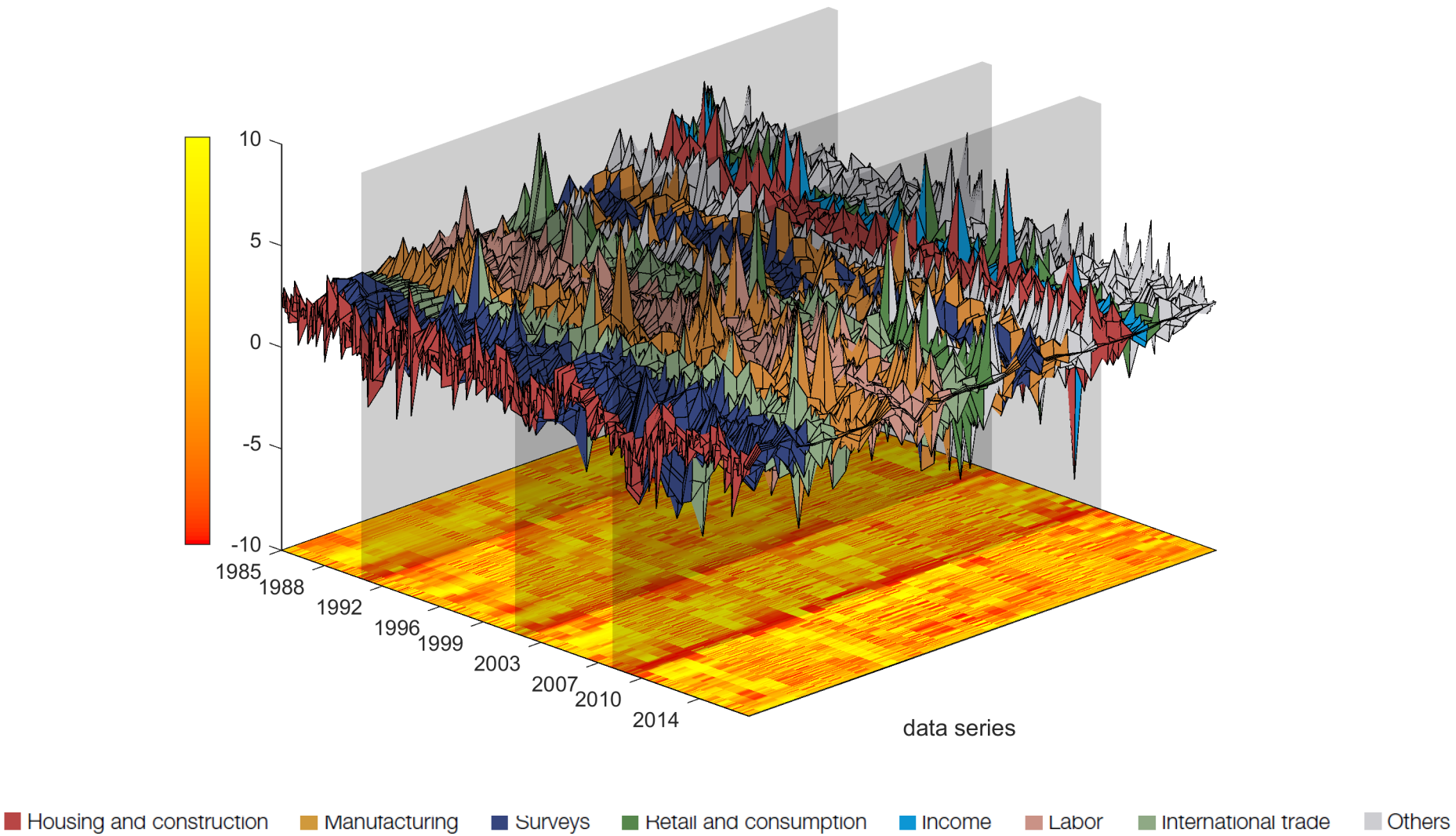

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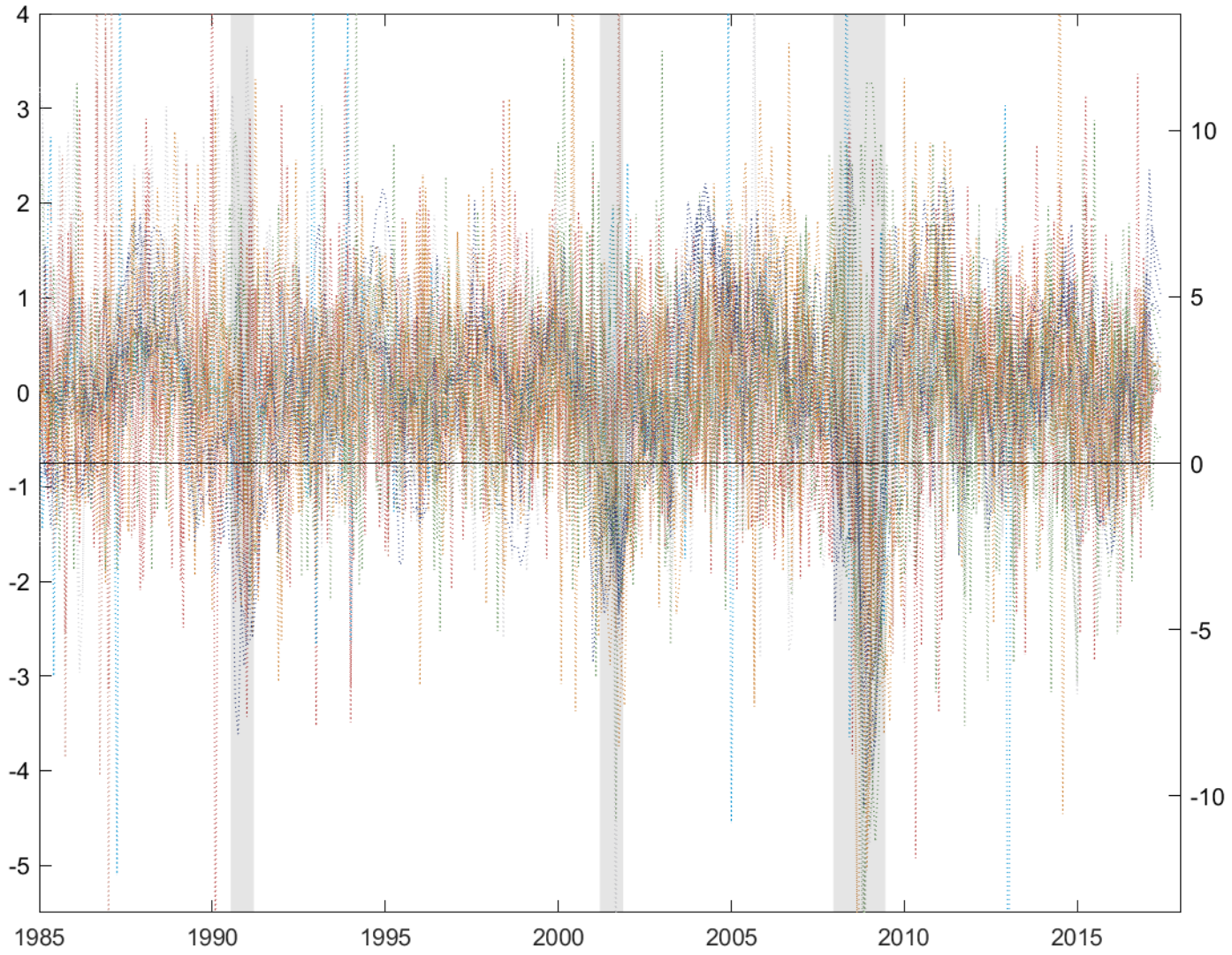

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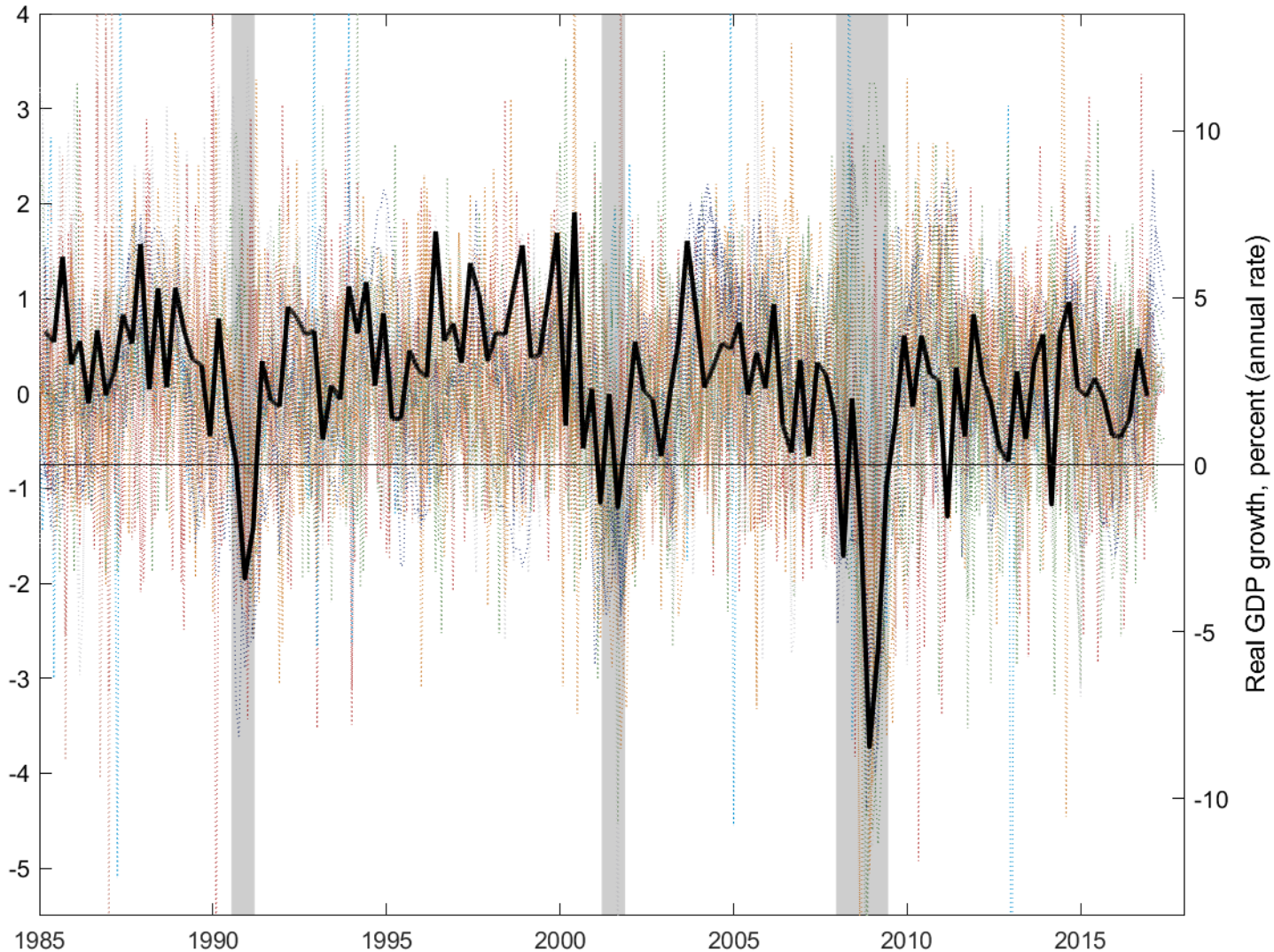
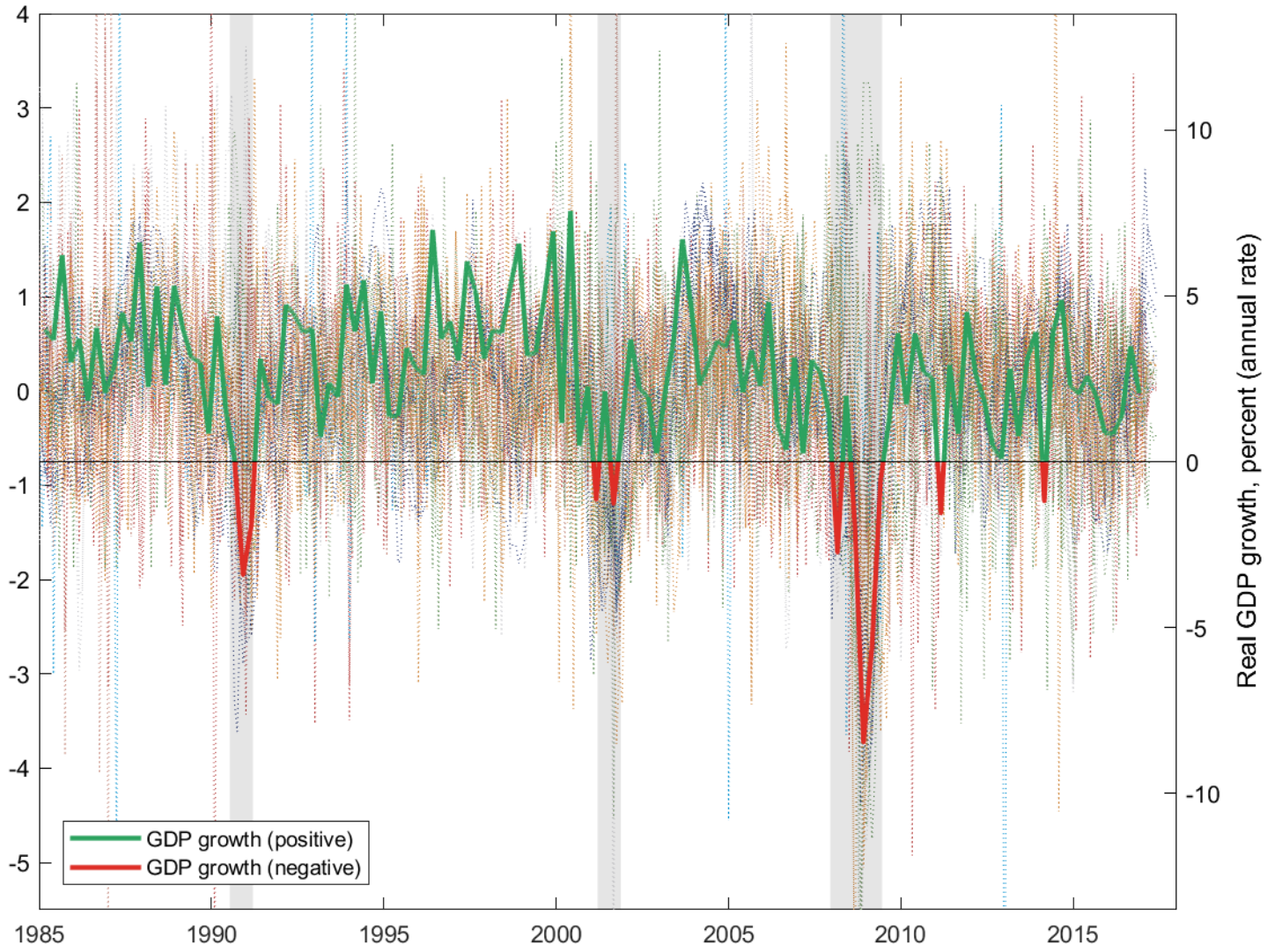


Burns and Mitchel meet Kuznet



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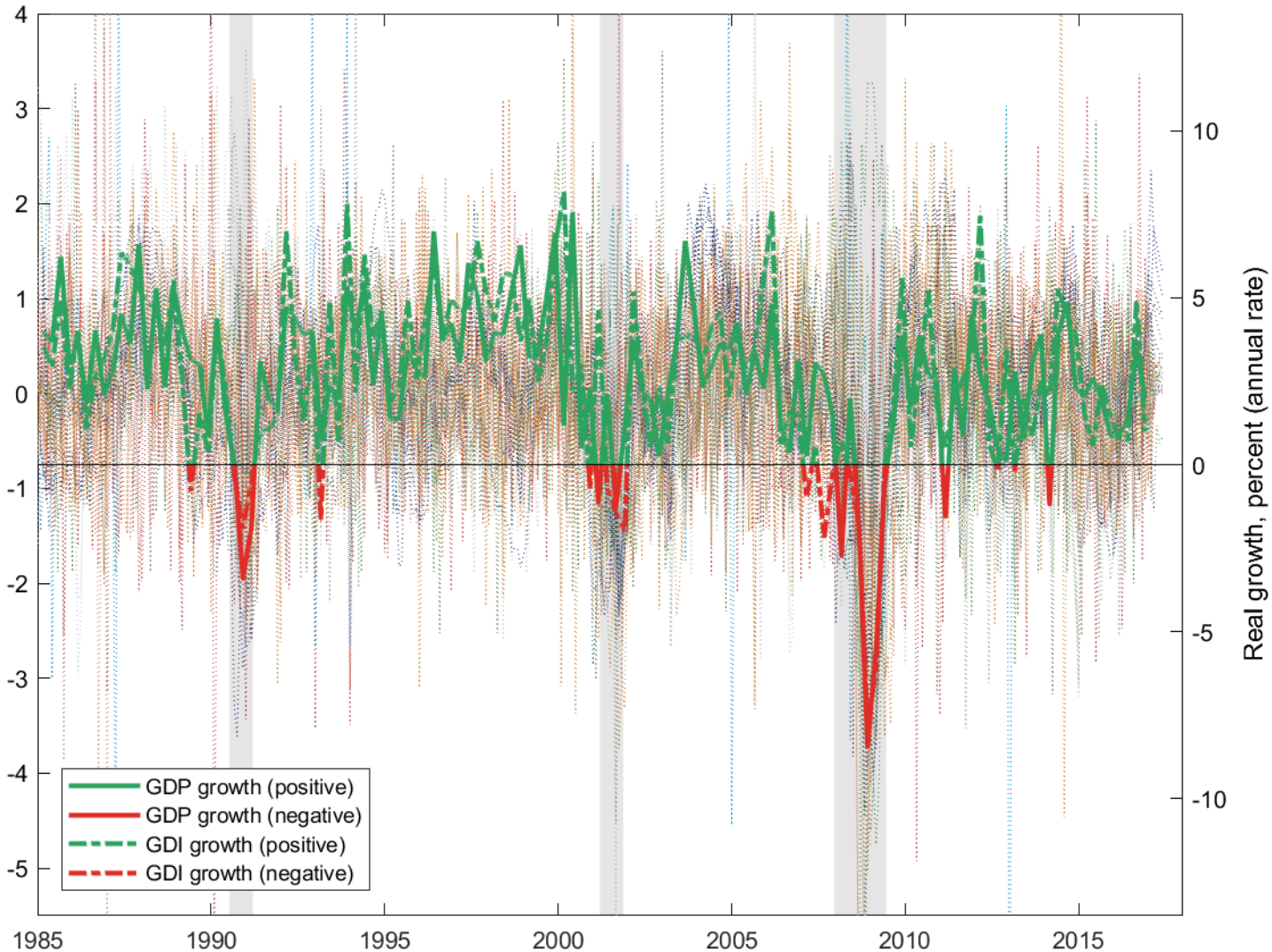

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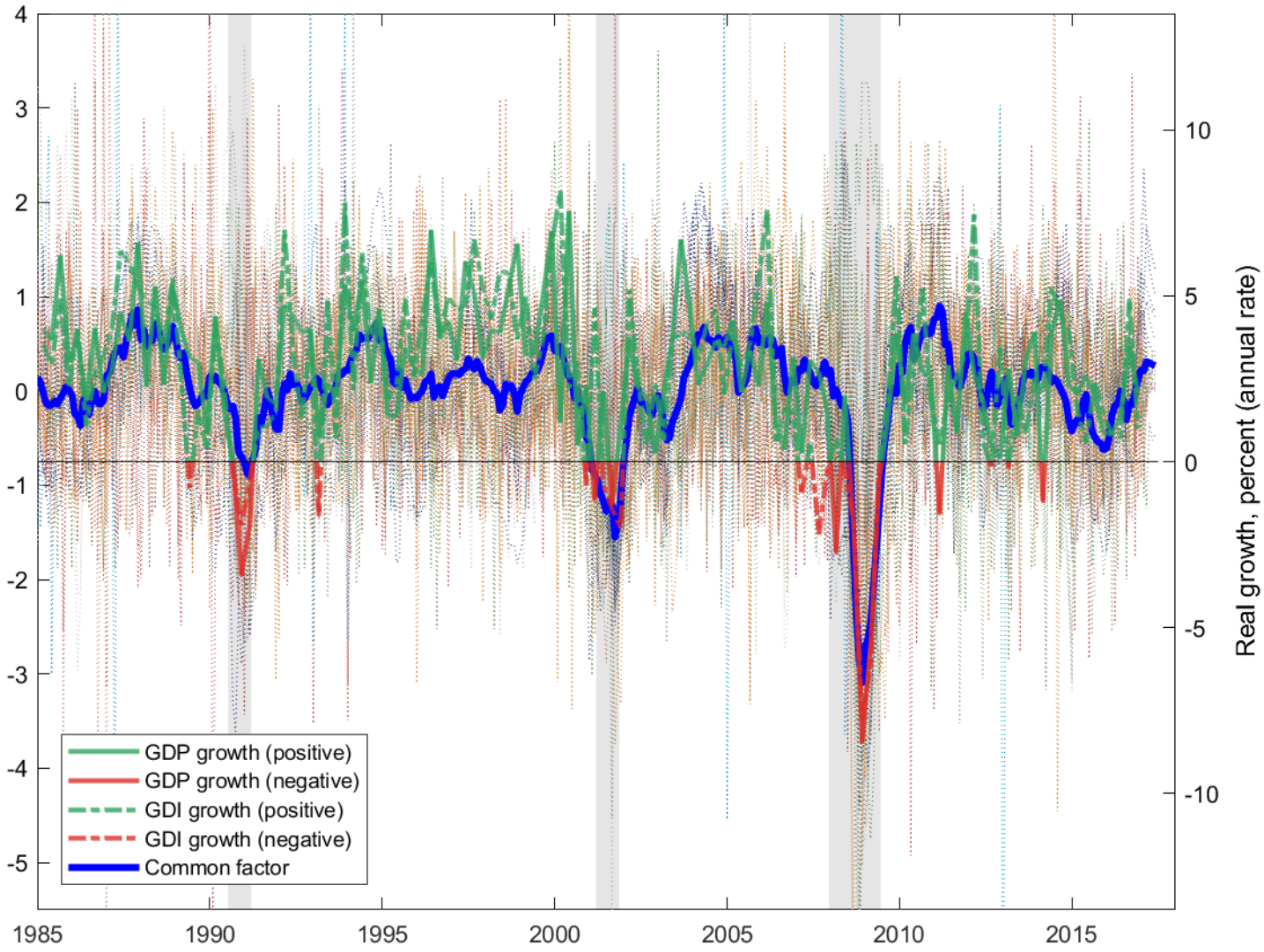
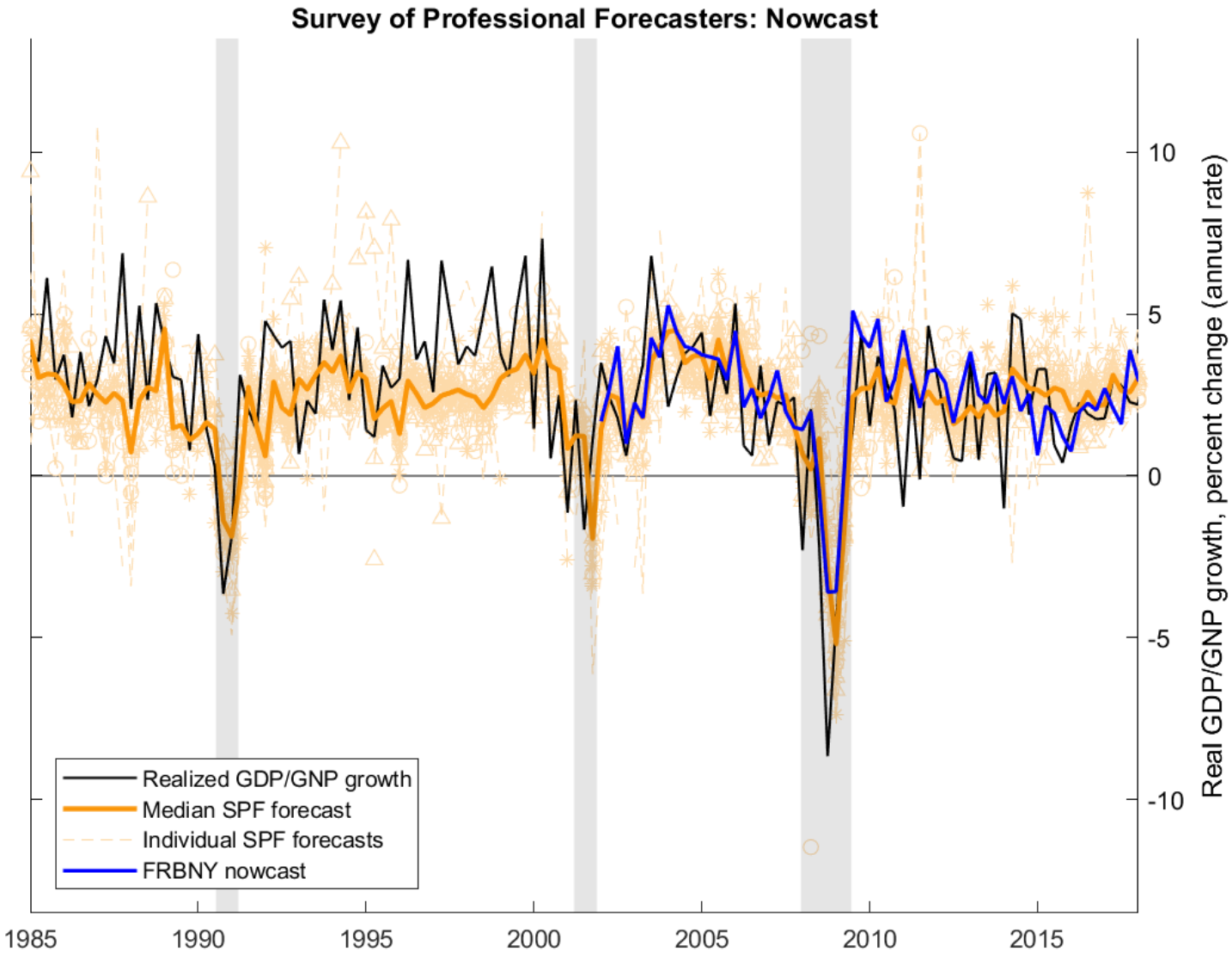


Forecasting with Judgment and Models



Alternative Data Sources

- What types of data are useful in the context of nowcasting?
- Is there a role for financial information?
- Is there a potential role for alternative data?
- Statistical agencies already produce big and high-quality macroeconomic data
  - Widely followed and intensively exploited
- It takes work to bring new alternative data to comparable quality
  - Distill signal from noise
    - Seasonality, outliers, other irregularities
  - Reliability and replicability
    - Setting standards, quality control