The Origins of Commodity Price Fluctuations

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Motivation

Understanding the underlying **drivers** of commodity price movements is **important**.

$\rightarrow$ *Differential implications of supply and demand (and their drivers) for*:

- **Macroeconomic outcomes**: [economic **growth**, countries' **financial resources** and **income distribution**, **inflation**, **real exchange rates**].

- **Firms' outcomes and decisions**: [**sales**, **investment**, **financing**].

- **Financial outcomes**. [Unprecedented interest in **commodity investing** during the past decade, **financialization**].

Classifying commodity price developments is crucial but **non-trivial**.

- **Model-based** methods.
  - VARs subject to specific orthogonality assumptions.

This paper

Indexes of commodity **supply** and **demand** using a **computer-based, narrative approach**.

- **General framework**: market-wide, commodity sentiment.
- **Tailored approach** covers different commodity categories. [energy, industrial and precious metals, agricultural commodities, livestock].
- Extract **main drivers** of commodities. [business cycle, geopolitical risk, natural disasters, and climate change].
- **Differential implications** depending on the **nature** of price developments:
  - For **macroeconomic outcomes** [demand has a larger impact on inflation].
  - For **firms' decisions** [different effect on cost of inputs, investment and sales].
  - For asset price **volatility** [demand is more important but supply matters too].

Contribution

- Flexible approach that spans the **global** commodity market.

- Indexes can be used **independently** or enrich and improve structural model-based predictions.

- Indicators track commodity price developments as news become available; **higher frequency** than standard macro variables.

- No need to pick a particular rotation of the shocks.
  - Important for the analysis during **COVID-19 crisis** when orthogonality assumptions are violated.

Positioning in the Literature

- **Textual analysis** for the **measurement** of various **economic outcomes**; [Tetlock, 2007], [Gentzkow and Shapiro, 2010], [Hoberg and Phillips, 2010], [Boudoukh et al., 2013], [Alexopoulos and Cohen, 2015] **[Baker et al., 2016]**, [Allcott and Gentzkow, 2016], **[Hassan et al., 2019]**, [Engle et al., 2020], [Caldara and Iacoviello, 2022].

- **Identification** of **supply** and **demand** shocks in **commodity markets** [focus on oil]: [Kilian, 2008; 2009], [Kilian et al., 2009], **[Wu and Cavallo, 2012]**, [Kilian and Vigfusson, 2016], [Känzig, 2021], **[Datta and Dias, 2019]**, [Loughran et al., 2019].

- **Narrative approaches** in **economics**: **[Romer and Romer, 2010]**.

Data description

- **Market-wide** news outlets:
  - **Reuters** (May 2000 to June 2020, 1,035,286 articles)
  - **Dow Jones** (Jan 2000 to June 2020, 2,760,967 articles)

- **Commodity specific publications** as Oil Daily (Dec 1996 to date, 110,333 articles); Platts Gas Daily (Nov 2001 to date, 89,146 articles); Metal Bulletin News Alert Service (Jan 2010 to date) etc. for **robustness**.

- Outlets accessed through **Factiva** - **Dow Jones**.

Methodology. A four-layer approach

News-reading simulation in **four steps**.

- **News intensity**. [**Count** of commodity-specific **articles**].

- **Content analysis**. [**Words** and **word combinations** attributed to **supply** and **demand** factors].

- **Refinement**. [Additional algorithm that caters to **exceptions** and **negations**. Creation of **thematic indexes**].

- Extensive **Human Auditing**.

Methodology
Content analysis: creating dictionaries

- **Content analysis**. [Identify **words** and **word combinations** that can be **attributed** to **supply** and **demand** factors].

- Running search for most "**popular**" words over selected articles.

- Classification of words into **supply** and **demand lists**. ▸ dictionaries
  - **Human checks** on use of words in a sample of articles.

- Use of standard dictionaries of "**increase**" and "**decrease**" words typically used in textual analysis with minor modifications for construction of **word combinations**.

- Retrieve number of supply, demand, increase and decrease words.

- Count number of **combinations** of **supply** or **demand** words with **directional** words, within the same sentence and within a certain range to the left and to the right of the supply or demand words.

- Build **net supply** [supply decrease minus supply increase] and **net demand** measures [demand increase minus demand decrease].

Standardized net supply and demand
Global commodity indexes

Net supply = supply decrease - supply increase
Net demand = demand increase - demand decrease
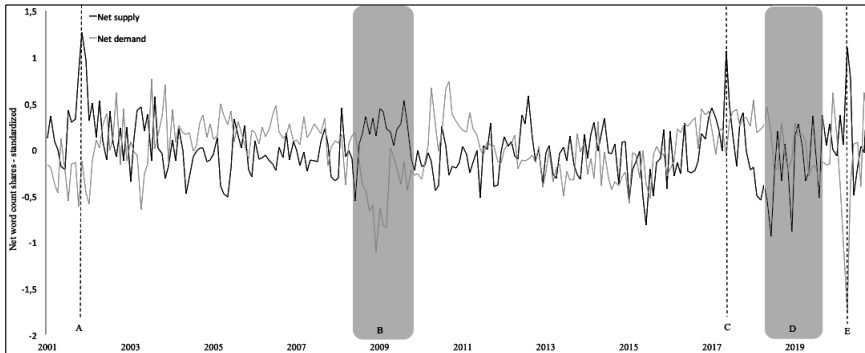
Note: This table plots the standardized net supply and demand indicators for the period between 2001 and 2020. The bars map a number of well-known commodity-wide developments. These events are: [A] 2001 US Recession, [B] Global Financial Crisis, [C] 172nd Meeting of the OPEC Conference – Production Cut, [D] Trade War, [E] COVID-19 Crisis.

Relationship with commodity returns

S&P GSCI Composite Daily Returns on Net Supply and Demand Indicators

|	Net Supply	Net Demand	Net Supply & Net Demand
Net supply	0.00306***		0.00346***
	(5.32)		(6.06)
Net demand		0.00408***	0.00436***
		(6.32)	(6.80)
Fed funds rate	-0.00377	-0.00510	-0.00782
	(-0.30)	(-0.40)	(-0.62)
VIX	-0.0002***	-0.0001*	-0.0001**
	(-3.72)	(-1.67)	(-2.17)
R2	0.017	0.025	0.034
N	3970	3970	3970

1st Principal Component of Commodity Returns & Standardized Net Demand

correlation = 0,46

standardized net demand   1st principal component of commodity returns
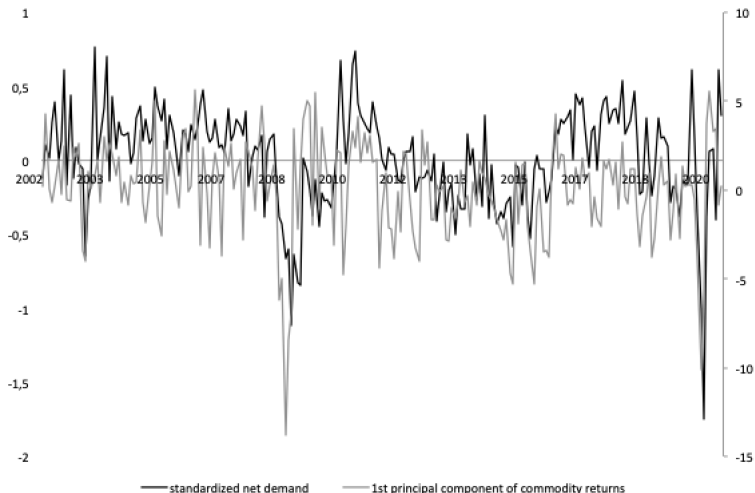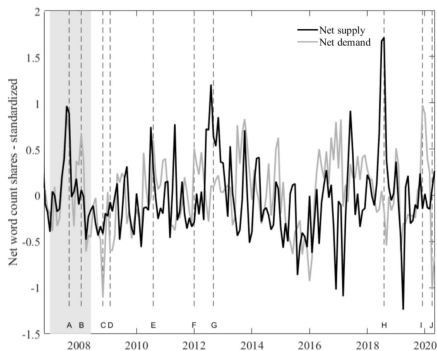
Standardized net supply and demand
Crude Oil
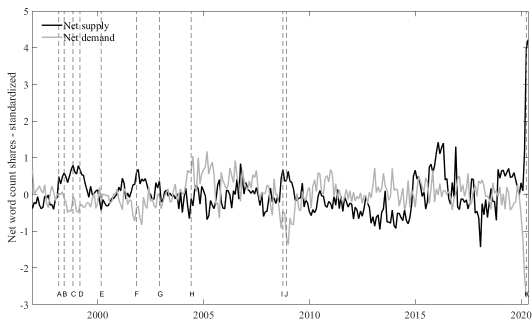
Note: This table plots the standardized net supply and demand indicators for the period between 1997 and 2020. The bars map a number of well-known oil sector developments. These events are: [A] 104th Extraordinary Meeting of the OPEC Conference – Production Cut (Asian Crisis), [B] 105th Ordinary Meeting of the OPEC Conference – Production Cut (Asian Crisis), [C] 106th Ordinary Meeting of the OPEC Conference (Asian Crisis), [D] 107th Ordinary Meeting of the OPEC Conference – Production Cut (Asian Crisis), [E] 109th Ordinary Meeting of the OPEC Conference: Production Increase Decision, [F] 118th Extraordinary Meeting of the OPEC Conference – Emergency OPEC Meeting after 9/11, [G] 122nd Extraordinary Meeting of the OPEC Conference – Production Cut, [H] 131st Extraordinary Meeting of the OPEC Conference: Production Increase, [I] 150th Extraordinary Meeting of the OPEC Conference – Production Cut (Global Financial Crisis), [J] 151st Extraordinary Meeting of the OPEC Conference – Production Cut (Global Financial Crisis), [K] 9th & 10th Extraordinary OPEC and non-OPEC Ministerial Meeting: Production Cut (COVID-19 Crisis).

Standardized net supply and demand

Wheat

Note: This table plots the standardized net supply and demand indicators for the period between 2001 and 2020. The bars map a number of important developments in the wheat sector. These events respectively are: [A] 2007-2008 World Food Price Crisis, [B] International supply shortages following large purchases from Japan and Egypt, [C] Replenishing of wheat stock and favorable global crop prospects, [D] Production of wheat is higher than utilization, [E] Drought in Russia and disruptive rainfall, [F] Projected utilization exceeding production, [G] Russian crop failure, [H] Major downward revisions in production projections due to heatwave across Russia, Australia, and EU countries, [I] Global wheat production is down with smaller crops in Russia and Australia more than offsetting larger crops in the European Union, [J] COVID-19.

Commodity-specific results

**Regression of S&P GSCI Commodity-Specific Daily Returns
on Net Supply and Demand Indicators**

Panel A. Energy

	Crude Oil	Gasoline	Natural Gas
Net demand (std.)	0.08135***	0.02928*	0.08955***
	(4.51)	(1.92)	(6.71)
Net supply (std.)	0.08974***	0.03366**	0.00029
	(6.26)	(2.51)	(0.02)
Fed funds rate	-0.02433**	-0.02361*	-0.01506
	(-2.25)	(-1.83)	(-0.97)
VIX	-0.08927***	-0.11481***	-0.02295
	(-2.78)	(-3.38)	(-1.42)
N	4889	4847	4833
R2	0.024	0.015	0.009

Commodity-specific results (cont.)

**Regression of S&P GSCI Commodity-Specific Daily Returns
on Net Supply and Demand Indicators**

Panel B. Industrial & Precious Metals

	Copper	Aluminum	Zinc	Gold
Net demand (std.)	0.17000***	0.03342**	0.02754**	0.07939***
	(10.93)	(2.50)	(2.20)	(6.38)
Net supply (std.)	0.06198***	0.04127***	0.04287***	0.01759
	(4.69)	(2.90)	(2.84)	(1.36)
Fed funds rate	-0.02363	-0.01117	-0.01194	0.01853
	(-1.43)	(-0.70)	(-0.62)	(1.19)
VIX	-0.07385***	-0.09143***	-0.07856***	-0.00126
	(-2.73)	(-4.68)	(-3.11)	(-0.05)
N	4882	4748	3863	4888
R2	0.040	0.011	0.008	0.007

Commodity-specific results (cont.)

**Regression of S&P GSCI Commodity-Specific Daily Returns
on Net Supply and Demand Indicators**

Panel C. Grains

	Corn	Wheat	Soybean
Net demand (std.)	0.11497***	0.13778***	0.12268***
	(8.76)	(10.69)	(9.47)
Net supply (std.)	0.03210**	0.10808***	0.07598***
	(2.34)	(3.81)	(5.07)
Fed funds rate	0.00324	0.01680	0.00071
	(0.21)	(1.18)	(0.05)
VIX	-0.02487	-0.01061	-0.03682*
	(-1.18)	(-0.57)	(-1.77)
N	4849	4878	4863
R2	0.016	0.033	0.022

Commodity-specific results (cont.)

**Regression of S&P GSCI Commodity-Specific Daily Returns
on Net Supply and Demand Indicators**

Panel D. Softs

	Sugar	Cocoa	Cotton
Net demand (std.)	0.11271***	0.09715***	0.11770***
	(8.02)	(5.86)	(7.83)
Net supply (std.)	0.07710***	0.04562***	0.07486***
	(5.78)	(3.29)	(5.03)
Fed funds rate	-0.01000	0.00260	-0.00480
	(-0.71)	(0.20)	(-0.37)
VIX	-0.02134	-0.02140	-0.04181**
	(-1.24)	(-1.16)	(-2.04)
N	4858	4842	4851
R2	0.020	0.013	0.022

Commodity-specific results (cont.)

**Regression of S&P GSCI Commodity-Specific Daily Returns
on Net Supply and Demand Indicators**

Panel E. Livestock

	Hogs	Live Cattle
Net demand (std.)	0.15884***	0.14736***
	(10.04)	(9.57)
Net supply (std.)	0.05816***	0.03526***
	(3.82)	(2.70)
Fed funds rate	-0.00376	-0.01932
	(-0.29)	(-1.39)
VIX	-0.02173	-0.05260**
	(-1.17)	(-2.00)
N	4704	3842
R2	0.031	0.028

Placebo Tests

Placebo Regression of S&P GSCI Commodity-Specific Daily Returns on Net Supply and Demand Indicators

Panel A.

	Corn on Aluminum	Wheat on Nat. Gas	Cattle on Soy	Gold on Oil
Net demand	0.00914	0.01112	0.01374	0.01158
	(0.69)	(0.87)	(0.90)	(0.82)
Net supply	0.00703	0.00392	0.02018	0.01146
	(0.50)	(0.29)	(1.30)	(1.00)
Fed funds rate	0.01795	0.02555	-0.01499	0.01999
	(1.13)	(1.72)	(-1.16)	(1.27)
VIX	-0.03394	-0.01579	-0.06167**	0.00470
	(-1.57)	(-0.82)	(-2.57)	(0.19)
N	4749	4834	4864	4890
R2	0.002	0.001	0.004	0.001

Response of global and OPEC oil production to oil supply
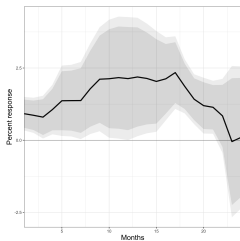
World, Supply Increase
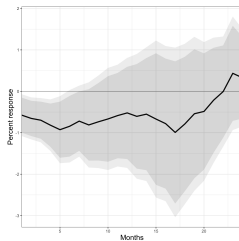
World, Supply Decrease
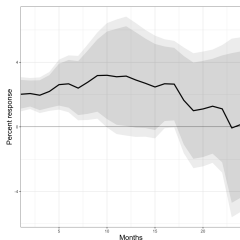
OPEC, Supply Increase
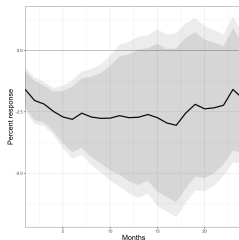
OPEC, Supply Decrease

Response of global copper production to copper supply
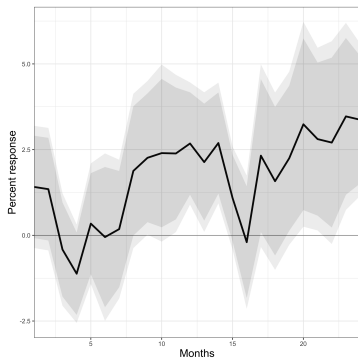
Response of Copper Production to Supply Increase
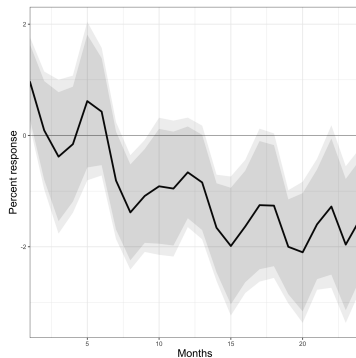
Response of Copper Production to Supply Decrease

Decomposition of commodity developments

- **Decompose** commodity indexes into different components [themes].
- Importance of themes is **time-varying**.
- Business cycle, geopolitical risk, natural disasters and climate change are identified as main drivers of commodity developments.

Decomposition of commodity developments
Business cycle
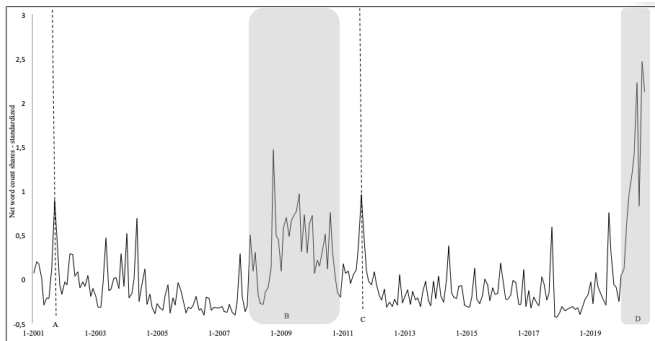
Note: This figure plots the Business Cycle Theme for the period between 2001 and 2020.
The bars map a number of important economic developments reflecting the state of the
business cycle. These events respectively are: [A] The 2001 recession, [B] Global Finan-
cial Crisis, [C] August 2011 stock markets fall over fears of contagion of the European
sovereign debt crisis [D] Covid-19 crisis.

Decomposition of commodity developments
Geopolitical Risk
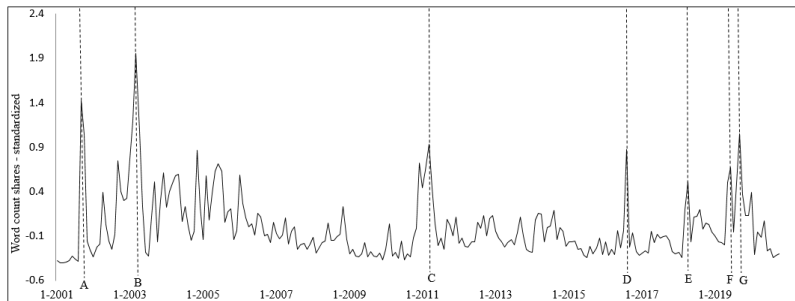
Note: Note: This figure plots the Geopolitical Risk Theme for the period between 2001 and 2020. The bars map a number of important geopolitical events. These events respectively are: [A] 9/11 attacks, [B] 2003 Iraq invasion, [C] Arab Spring: Syrian and Lybian War, [D] Militant attacks on oil infrastructure in Nigeria, [E] Trade war escalation between the United States and China, [F] U.S.-Iran tensions, [G] Major Saudi Arabia oil facilities (Abqaiq and Khurais) hit by Houthi drone strikes.

Decomposition of commodity developments
Natural Disasters
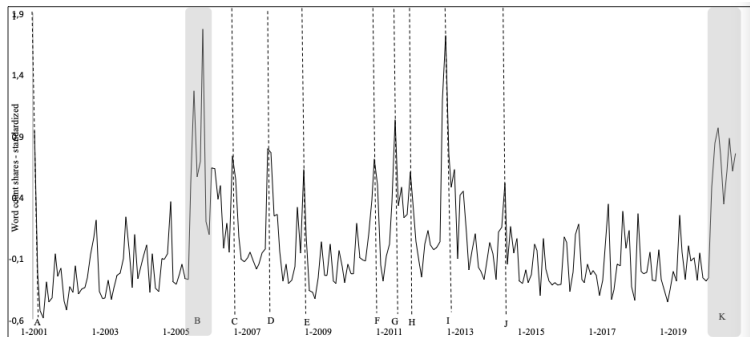
Note: This figure plots the Natural Disasters Theme for the period between 2001 and 2020. The bars map a number of important natural disasters. These events respectively are: [A] 2001 Gujarat earthquake, [B] 2005 Atlantic hurricane season (Katrina, Emily), [C] 2006 Atlantic hurricane seasons and severe droughts across Europe and US, [D] 2007 Atlantic hurricane seasons and severe droughts across Europe and US, [E] 2008 Atlantic hurricane seasons, [F] Severe droughts in the Black Sea Region, [E] 2008 Atlantic hurricane seasons, [G] The Great East Japan Earthquake, [H] 2011 Atlantic hurricane seasons, [I] US Summer 2012 Drought, [J] 2014 Iquique earthquake and droughts in Brazil, [K] COVID-19 crisis.

Decomposition of commodity developments
Climate Change
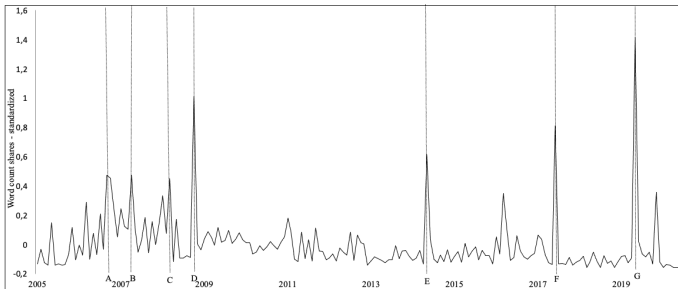
Note: This figure plots the Climate Change Theme in commodity-related articles between 2005 and 2020. The bars map a number of well-known climate change developments. These events are: [A] IPCC Fourth Assessment Report issues its strongest warning ever that human activities are causing a damaging global warming, [B] Fourth session of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol and fourth workshop under the dialogue on long-term cooperative action to address climate change, Austria, [C] G8 Climate Agreement, Hokkaido, [D] (i) President Barack Obama calls for investment in clean energy and for carbon cap-and-trade legislation at its first speech to a joint session of Congress (ii) Climate change wake-up call following bushfires in Australia, [E] 2014 UN Climate Summit, New York, [F] E.P.A. Announces repeal of major Obama-era carbon emissions rule "Clean Power Plan", [G] 2019 UN Climate Action Summit, New York.

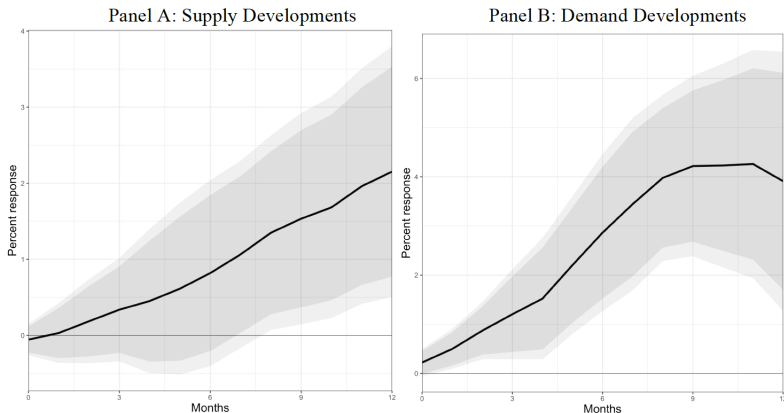# Application I. Impact on Macro Variables
CPI Inflation
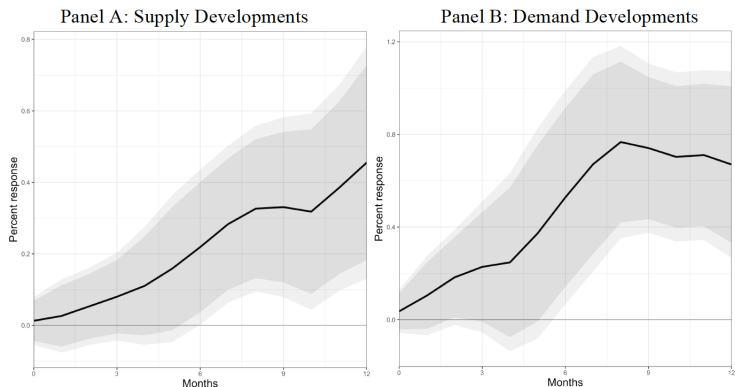
Note: Percentage CPI inflation (year-on-year) response following a one standard deviation increase in supply and demand developments, contemporaneously, and up to a twelve-month horizon (90% and 95% CI). Controls: industrial production log change, GSCI log returns, S&P 500 log returns, FFR, 10-year minus 2-year US treasury, VIX, trade-weighted US dollar log returns. Each specification also includes a constant and p lags of CPI inflation determined by the BIC.

Impact on Macro Variables
PPI Inflation

Note: Percentage PPI inflation (year-on-year) response following a one standard deviation increase in supply and demand developments, contemporaneously, and up to a twelve-month horizon (90% and 95% CI). Controls: industrial production log change, GSCI log returns, S&P 500 log returns, FFR, 10-year minus 2-year US treasury, VIX, trade-weighted US dollar log returns. Each specification also includes a constant and p lags of CPI inflation determined by the BIC.

Conclusion

- **Novel indexes** of commodity price **supply** and **demand** developments using **textual analysis**.

- Indicators measure the **intensity**, and **direction** of commodity news, and **track** major **developments** in commodity markets.

- **Useful** tool in the light of the recent **COVID-19 crisis** when supply and demand **shocks** are **frequent**, **large**, and **not necessarily orthogonal**.

- Supply and demand developments appear to have **different implications** for a number of **macroeconomic outcomes**, and **firm-level decisions**, stock-market **volatility** and **cross-asset correlations**.

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– Appendix –

Methodology

Dictionary examples

Global Commodity Index
Supply

suppl* produc* output

Demand

demand* consum* buy* purchas*

Crude Oil
Supply

suppl* produc* output discovery glut*
reserv* surplus* rig*

Demand

demand* consum* buy* util* drain*
deplet* refin*

Wheat
Supply

suppl* produc* output crop*
planting* farm* harvest*

Demand

demand* consum* buy* purchas*
flour* feed* miller*