INTERNET WEB APPENDIX

SUPPLEMENTAL MATERIALS FOR

Determinants of Commodity Market Liquidity

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In this web appendix, we provide additional data description relating to Table 1 in the manuscript, Stage 1 regression output for computing active position taking (APT) measure in Table A, GSCI constituents and the Large Trader Definition in Table B, Stage 1 regression for computing Residual Amihud Price Impact in Table C, robustness test regression output for Amihud Price Impact without Volume in Table D, robustness test regression output for Amihud Price Impact regression with Working's T in Table E, and time-series graphs of liquidity measures aggregated for all commodities and for WTI in Figure F.

Additional Data Description

Our data source is the U.S. CFTC's Large Trader Reporting System (LTRS) and are composed of end-of-day long and short positions of futures and delta-adjusted options for each large trader.[1] While the position data are supplied by reporting firms (FCMs, clearing members, foreign brokers and exchanges), the actual trader category that is used to classify them as end-user commercial traders or non-commercials is based on the predominant business purpose, which is self-reported by traders on the CFTC Form 40 and is subject to review by CFTC staff

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[1] A large trader is a trader with a position greater than a specific threshold number of contracts, which differs across contracts. Large traders represent about 85%-90% of the open interest in the contracts evaluated in this study (Robe and Roberts (2019)). See Internet Appendix Table B for the large trader definitions across each commodity market we investigate. Other papers that use LTRS include Dewally, Ederington and Fernando (2013) and Brunetti and Reiffen (2014).

for reasonableness. It is likely that commercial traders' positions primarily reflect a desire to reduce their inherent risk from their main line of business (i.e., they are hedgers). The other participants in futures markets who have no innate position in the physical commodity are referred to as non-commercials (speculators). The non-commercial category, for example, includes hedge funds, who have no physical position in the underlying commodity, but instead take long or short positions to take advantage of what they view as favorable prices. Non-commercial traders typically make bids and offers on the same day, serving as market makers by effectively providing liquidity to other market participants.

Here we provide additional interpretations of the descriptive statistics of the data used in our analysis, as presented in Panel A of Table 1 included in the manuscript. The average Amihud price impact (PI) measure has a much larger magnitude across individual commodity contracts (0.61) compared to the price impact (MPI) of the GSG market index ETF (0.05), suggesting the market index is highly liquid compared to individual commodity markets.[2] The Microstructure Noise measure is designed to be bounded by 0 at the lower end when there is no microstructure noise present. On average, it indicates a transitory movement in prices that is a slightly higher than double what we see in permanent price movement levels (1.15). The trader concentration measure (Conc), with the theoretical range between 0 for perfect competition and 1 for monopoly, has the average value of 0.04 which indicates that the markets are on average competitive. For each contract market's top trader's position expressed as the aggregate of its of open interest in futures and options across all markets is about 59 thousand contracts. The top

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[2] The Residual Amihud Price Impact measure we use in our robustness analysis has a much lower value (0.004) on average by design.

trader average breadth of participation is close to 10 commodity markets suggesting a significant division of their capital and attention across the commodity markets they actively participate in.[3] Next, we present the trader level inventory deviations (deviations of individual traders' inventories from their own target inventory) aggregated at commercial and non-commercial trader category level with two different proxies. The first proxy measures the inventory deviations relative to target inventory proxied for by the past 90-day median level inventory, normalized by open interest of the lead month contract. We present this measure separately for commercials that are swap dealers and for those that are not swap dealers. The hedging demand from the former group is slightly higher (0.15), on average, than that of the latter (0.09). In comparison, the supply of market making by the non-commercial traders is larger (0.43) when compared to both.[4] Non-commercial participants sometimes also want to actively build speculative positions of their own over and above their market making activities. Our unique dataset allows us to examine this directly. The orthogonalized active position taking by non-commercial traders in excess of commercial trader's hedging demand is 0.02. The second set of inventory deviation measures where the target inventory set to zero have lower values for commercial and non-commercial traders than when target is set to past 90-day median position, but more importantly they are close in size. This is consistent with the idea that non-commercial traders play an important market making role for commercial hedgers in commodity markets. Finally, the Working's T measure we calculate using publicly available data indicates, on average, a small level of excess speculation in the markets (1.17).

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[3] We present normalized versions of the top trader's position and breadth in Panel A of Table 1.

[4] While we do not use the aggregate deviation from 90-day median level inventory measure for non-commercials in our regressions, we nevertheless report it in our descriptive statistics for comparison purposes.

Additional Tables

A. Active Position Taking by Non-Commercial Traders

Table A.

Stage 1 regression for computing active position taking (APT) measure. The table presents regressions of non-commercial inventory deviation from zero ($InvDevZero_{NC}$) on commercial inventory deviation from zero ($InvDevZero_C$. Residual from this regression represent APT for Table 3. t-stats for each estimate are shown in the columns proceeding the estimates.

Dependent Variable: $InvDevZero_{NC}$

	Coefficient		t
Intercept	4549.06	***	36.25
$InvDevZero_C$	-0.89	***	-811.41
N	87753		
R^2	0.88		

B. GSCI constituents and the Large Trader Definition

A large trader is one who holds or controls a position in any one future or any one option expiration series of a commodity on any one exchange equaling or exceeding the exchange or CFTC-specified reporting level. Under the Commission's LTRS, clearing members, FCMs, and foreign brokers (collectively called reporting firms) file daily reports with the Commission under Part 17 of the CFTC's regulations. If, at the daily market close, a reporting firm has a trader with a position at or above the Commission's reporting level in any single futures or option expiration month, the firm reports that trader's entire position in all futures and options expiration months in that commodity, regardless of size. Current large trader reporting threshold levels, which are found in CFTC Regulation 15.03(b).[5]

The table below presents the constituents of the GSCI and their corresponding weights (first column) and the number of contracts needed to be classified as a Large Trader (second column) as of 2020 as well as the average open interest across all years (2001-2020). The information on GSGI weights is obtained from Bloomberg. The thresholds for the large trader definition are obtained from the Federal Registrar, which is published pursuant to CFTC Regulation 15.03(b). The data on open interest are from the LRTS. Note that 7 of the 24 contract markets included in the GSCI index are not traded in CME and as a result are not part of the LTRS data we are using and do not have corresponding large trader threshold definitions. We mark the value of large trader threshold and average open interest as N. The only exception is the LME Copper where we use the corresponding CME contract since it is highly active.

Table B.

Commodity	Weight in the GSCI (2020)	Large Trader Threshold (2020)	Average open interest (2001-2020)
Chicago Wheat	2.85%	150	180,242
Kansas Wheat	1.25%	150	81,078
Corn	4.90%	250	520,875
Soybean	3.11%	150	244,606
Coffee	0.65%	50	80,850
Sugar	1.52%	500	305,714
Cocoa	0.34%	100	74,483
Cotton	1.26%	100	102,295
Live cattle	3.90%	100	114,298
Feeder cattle	1.30%	50	15,064
Lean Hogs	2.05%	100	73,923
WTI Crude Oil	25.31%	350	314,005
Brent Crude Oil	18.41%	N	N
Gas Oil	5.95%	N	N
Heating Oil	4.27%	250	79,285
RBOB Gasoline	4.53%	150	94,958
Natural Gas	3.24%	200	184,580
Aluminum	3.69%	N	N
LME Copper	4.36%	100*	85,118*
Lead	0.68%	N	N
Nickel	0.80%	N	N
Zinc	1.12%	N	N
Gold	4.08%	200	252,155
Silver	0.42%	150	86,956
Sum (all)	100%		
Sum (18 contract markets in sample)	69%		

C. Residual Amihud Price Impact

Table C. Stage 1

Stage 1 regression for computing Residual Amihud Price Impact. The table presents regressions of Amihud Price Impact (PI) on Market Price Impact (MPI) and VIX . t-stats for each estimate are shown in the columns proceeding the estimates. Residuals from this regressions represent the idiosyncratic illiquidity for Stage 2 regressions below.

Dependent Variable: *Amihud PI*

	Coefficient		t
Intercept	0.15	***	14.98
MPI	1.30	***	22.41
VIX	19.62		44.86
N	65421		
R^2	0.04		

D. Amihud Price Impact without Volume

Table D

	Coeff	t	beta
Conc	1.87***	3.12	0.05
Breadth	0.03	0.93	0.01
SizeTop	-2.08***	-3.55	-0.06
APT_NC	-0.47	-0.93	-0.01
InvDevMedND	229.81***	3.69	0.18
InvDevMedSD	0.43***	3.15	0.04
SLR	0.20***	2.99	0.09
InvDevZeroNC	-0.75*	-1.78	-0.04
SLR_InvDevZeroNC	0.20	0.59	0.01
MPI	0.54***	4.76	0.04
VIX	15.16***	5.63	0.13
Trend	-0.01***	-8.15	-0.22
Constant	0.50***	5.97	
Observations	64,411		
R-squared	0.35		
Y FE	N		
Quarter FE	Y		
CM FE	Y		

E. Amihud Price Impact Regression with Working's T

Table E	(1) Amihud			(2) MS Noise			(3) Residual Amihud		
	coeff	t	beta	coeff	t	beta	coeff	t	beta
Conc	1.17**	2.20	0.03	0.02	1.43	0.03	0.62	1.17	0.02
Breadth	0.02	0.46	0.00	-0.00	-0.14	-0.00	0.03	0.99	0.01
SizeTop	-2.01***	-3.77	-0.06	-0.03**	-2.42	-0.05	-2.09***	-3.70	-0.07
Working's T	-0.02	-0.15	-0.00	-0.00***	-4.08	-0.06	-0.04	-0.26	-0.00
InvDevMedND	181.48***	3.14	0.14	-0.07	-0.35	-0.01	187.41***	3.34	0.15
InvDevMedSD	0.27**	2.21	0.02	0.01***	3.89	0.10	0.06	0.39	0.01
SLR	0.17***	3.02	0.07	-0.00	-1.26	-0.06	-0.41***	-6.74	-0.18
InvDevZeroNC	-0.59**	-2.11	-0.03	0.00	0.31	0.01	-0.54*	-1.94	-0.03
SLR_InvDevZeroNC	0.59**	2.21	0.03	0.02**	2.10	0.10	0.51*	1.99	0.02
MPI	0.49***	4.28	0.03						
MPI Noise				0.28***	5.17	0.13			
VIX	15.08***	6.28	0.13	0.18***	5.06	0.13			
Volume	-0.38***	-8.46	-0.40	0.00***	12.14	0.39	-0.37***	-8.29	-0.41
Trend	-0.01***	-6.80	-0.13						
Constant	4.39***	8.92		-0.03***	-6.04		4.01***	7.83	
Observations	64,411			44,599			64,411		
R-squared	0.37			0.17			0.35		
Y FE	N			Y			Y		
Quarter FE	Y			Y			Y		
CM FE	Y			Y			Y		

F. Time-series Graphs of liquidity measures aggerated for all commodities and for WTI

F.1 MPI Amihud Graph
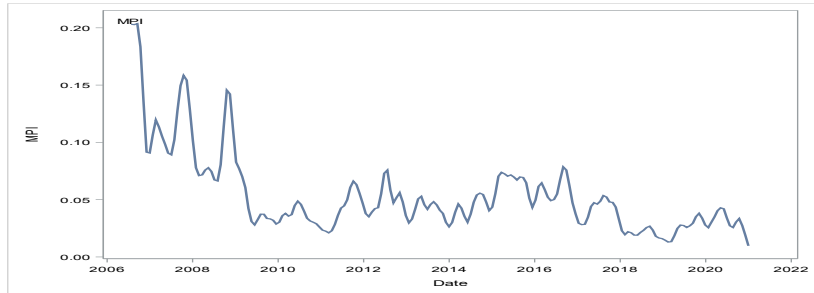
F.2 MPI Microstucture Noise Graph
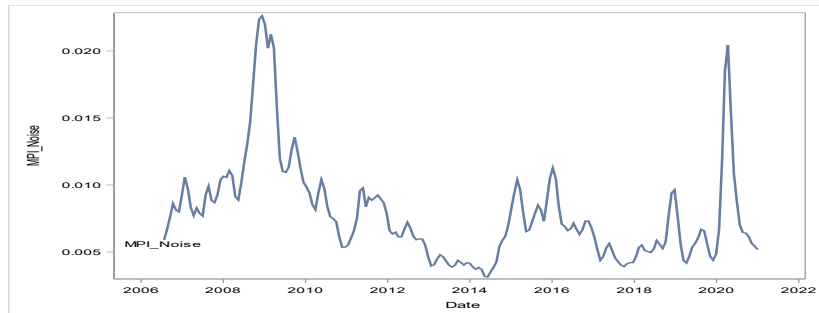
F.3 WTI Residual Amihud Graph