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Who Influences the Fundamental Value of Commodity Futures in Japan?⋆

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Abstract

We present evidence on the asymmetric information content of six investor groups' transactions in the gold, platinum, gasoline and rubber futures markets on the Tokyo Commodity Exchange. Microstructure theory suggests that traders with superior information regarding the efficient price should be more profitable in the long run. We find that foreign investors have the greatest influence over the efficient price in the gold market, domestic retail investors in the gasoline market and domestic investment funds in the platinum and rubber markets. Differences in the relative influence of investor groups over commodity futures are likely to reflect the degree of contract homogeneity and associated market liquidity. Foreign (domestic retail) investors have larger information shares for the homogeneous liquid (heterogeneous illiquid) contracts than for the heterogeneous illiquid (homogeneous liquid) contracts.

Keywords: Asymmetric information, Commodities, Futures, Investor behaviour, Market microstructure

JEL: C32, G14, G15, Q02

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1. Introduction

Financial market analysts and investors routinely attempt to identify the market positioning of "smart money" traders, those who are believed to trade profitably on valuable private information about the future course of financial securities prices. The market positioning of such smart money traders reveals their return expectations. Mimicking the market positions of the smart money is expected to be a profitable trading strategy if implemented efficiently enough with respect to trading costs and time. Market participants are also interested in identifying those who trade on noise. Sophisticated investors trade against "dumb money" traders with the expectation that market prices will correct and the dumb money will be forced out of their positions.

Who are the smart money investors that trade on valuable private information regarding the future paths of securities prices? Identifying which traders possess information, and how information enters prices, are central issues in market microstructure. Informed investors possess private information. Their trades incorporate this new private information in a security's price and have a lasting impact on the price (Hasbrouck, 1991a,b, 2007). That is, informed investors' trades influence the "efficient price" of a security. Accordingly, their investment activities are expected to be profitable in the long run.

Empirically, the identification of informed investors remains an important open question (Menkhoff and Schmeling, 2010; Hasbrouck, 2007). The primary constraint on empirical work is the lack of suitable transaction-level data that match the identity of traders with their trades (Dewally et al., 2013). We take advantage of transaction data associated with new investor classifications recently introduced by the Tokyo Commodity Exchange (TOCOM). The new classifications provide a daily breakdown of transactions over six investor groups that represent the type of investor who initiated the trade.

In this study, we modify the method proposed by Hasbrouck (1991a,b) to identify which of six investor groups are better informed in the gold, platinum, gasoline and rubber futures markets on TOCOM. Hasbrouck analyses the interaction of order flow and price revisions using a bivariate structural vector autoregression (SVAR) that isolates the random-walk and stationary components of price. The former is considered as the efficient price and the latter mispricing. This approach also measures the information content of trade by decomposing the efficient price variance into a trade-related component and a non-trade-related component. We use a multivariate SVAR to identify the influence of trades by each investor group on the efficient price.

The trade-related components can be interpreted as the private information contained in the trades of each investor group, while the orthogonal non-trade-related component reflects public information. Private information enters the price of a security through the trading activity of informed traders. Investor groups that have a positive long-run impact on price, and a substantial influence on the efficient price, are expected to be informed and have superior investment performance in the long run.

We compare four commodity futures with different contract homogeneity and market liquidity characteristics to shed light on the reasons that lie behind differences in the information content of investor groups' trades. Gold and platinum contracts are homogeneous in that they trade on several exchanges around the world with virtually identical specifications of the underlying commodity. Gasoline and rubber contracts are heterogeneous as there are substantial differences between the underlying commodity specification of the TOCOM contract and those on other important exchanges. We measure relative liquidity using the long-run price impact of trade derived from the SVAR model for each commodity. Gold and platinum are relatively liquid, while gasoline and rubber are relatively illiquid.

We find the following. First, the efficient price in the gold, platinum and gasoline markets is mainly influenced by private information (that is, trade-related components), while both private and public (that is, non-trade-related) information have equal influence over the efficient price of rubber. Second, foreign investors have the greatest influence over the efficient price in the gold market, domestic retail investors in gasoline and domestic investment funds in both platinum and rubber. Third, the types of investors who are informed in a commodity futures market are likely to reflect the degree of contract homogeneity and the associated market liquidity conditions. Foreign investors have larger information shares for the homogeneous liquid contracts than for the heterogeneous illiquid contracts. In contrast, domestic retail investors have larger information shares for the heterogeneous illiquid contracts than for the homogeneous liquid contracts.

Our main contributions to the literature are threefold. First, we determine which investor groups are informed and uninformed, and thus which types of investor generate profits from their trading over the long run. Market microstructure theories suggest that better-informed traders make superior returns by trading on their private information at the expense of uninformed traders (Grossman and Stiglitz, 1980; Glosten and Milgrom, 1985). To our knowledge, there is no published research comparing the long-run profitability of different types of investors in the commodity futures markets. Our research differs from previous approaches which aim to identify the influence of investor trading activity on price using VAR models, such as Kamesaka et al. (2003) and Karolyi (2002). Without incorporating information on investors' holding periods, such VAR approaches are unable to definitively infer which investors permanently influence price or their profitability[1]. We address this limitation by modifying Hasbrouck's approach to identify informed investor groups which allows us to infer performance over the long run.

Second, we explain our results in terms of contract homogeneity and market liquidity. Our result that foreign investors have relatively large information shares in the homogeneous liquid contracts suggests foreigners may have an advantage in global information. In contrast, domestic retail investors have relatively large information shares in the heterogeneous illiquid contracts which suggests they may have an advantage in local information. Global information is likely to be important for foreigners trading the more international homogeneous futures while local information is likely to be useful for domestic retail investors trading the more local heterogeneous contracts. Foreigners are predominantly institutional investors and are likely to prefer the more liquid homogeneous contracts in which they can make large transactions more easily. Domestic retail investors are typically small traders, so the relative illiquidity of the heterogeneous commodities is unlikely to be a substantial barrier to their participation. Our results are comparable with the findings in equity markets that suggest foreign investors prefer more international and liquid stocks (Dahlquist and Robertsson, 2001), foreigners prefer larger firms (Kang and Stulz, 1997), and domestic investors prefer more local stocks (Grinblatt and Keloharju, 2001). Price slippage on trades may be a problem for foreign investors, as observed by Choe et al. (2005) for stocks.

Third, we exploit the data associated with TOCOM's new investor classifications. The advantage of this data is that trades are classified according to investor groups that have common trading motivations. This allows us to make useful inference regarding the investor groups and the information content of their trades. As far as we are aware, TOCOM is one of the few commodity exchanges that make such aggregated daily transaction data publicly available.

Our findings have three main implications for practitioners. First, investors are keen to know who are the informed and uninformed traders. We demonstrate this for traders aggregated to

[1]Other information may also be required. For example, regarding the profitability of investors, Karolyi (2002) notes "The nature of the TSE data precludes our ability to answer this question directly. After all, we only have weekly total purchase and sales activity of foreigners and various types of domestic investors, we have only aggregate level data by investor class, and we do not know specifically which securities they invested in."

six groups, within which traders have a similar motivation for trading. Identifying informed traders is likely to influence the behaviour of the other traders in the market. Second, our analysis offers insights for commodity futures exchanges about market design. Homogeneous liquid futures are likely to present an attractive opportunity for foreign investors to trade where they have an advantage in global information, while small domestic investors may trade at an informational disadvantage. On the other hand, a heterogeneous contract is likely to favour small domestic investors and increase their incentive to trade on the exchange, despite being relatively less liquid. Success in the global competition between commodity futures exchanges is likely to require a balance between these approaches. Third, questions about speculative activity and commodity futures market stability require regulators to have knowledge regarding which investors may be stabilising or destabilising, which investors may be liquidity providers and how price risk is transferred between different types of traders. Our approach provides a method to analyse and monitor commodity futures trades and returns in order to answer these questions.

The article proceeds as follows. In Section 2, we survey the relevant literature. In Section 3, we discuss the four futures markets, six investor groups and the data. In Section 4, we explain our model. In Section 5, we present and interpret our results. Section 6 concludes.

2. Related Literature

A substantial body of literature examines which types of investors have superior information or performance in trading securities. Most of this research has been conducted on equity markets, where foreign versus domestic investors, or other investor types are examined. A relatively small but enlightening literature also exists for commodities.

Several studies relate the degree of efficiency in securities prices with the trading activities of certain types of investor. Boehmer and Kelley (2009) show that stocks with higher institutional ownership are more efficiently priced. He and Shen (2014) show that Japanese stock prices are more efficient for firms with large changes in foreign ownership. Bae et al. (2012) suggest emerging market stocks that are more investible to foreign traders incorporate global information faster than stocks that are less investible to foreigners. However, Qin and Bai (2014) find emerging market stocks that are fully investible for foreign investors exhibit stronger price momentum than non-investible stocks, although foreign investors do not appear to under-react to firm-specific information.

Another popular approach is to analyse the investment performance of different types of investors. Many of these studies suggest that foreign investors achieve superior performance. Foreign investors, securities firms and banks perform well according to a VAR of investment flows and Japanese equity index returns in Kamesaka et al. (2003), while individual investors perform poorly. Karolyi (2002) uses a VAR of transactions and returns to show the foreign investors did not destabilise the Japanese stock market during the Asian financial crisis, and suggests they profited over the period while banks and corporations lost[2]. Seasholes (2000) concludes that foreign institutional investors outperform residents and time firms' earnings announcements well in Taiwan[3]. Seasholes (2004) finds that foreign investors outperform domestic investors in the stocks of large well-known firms in emerging markets. Foreigners are found to be superior stock pickers in Grinblatt and Keloharju (2000) and have superior market timing ability in Hamao and Mei (2001)[4]. Albuquerque et al. (2009) suggest that US international investors have superior global private information compared with foreign investors based in other countries.

However, Timmermann and Blake (2005) find foreign investors to be poor market timers, while Shukla and van Inwegen (1995) find that UK mutual funds investing in the US perform worse than US domestic funds partly due to informational disadvantages. Choe et al. (2005) show that in Korea, foreign money managers pay more than domestic money managers when they buy, and receive less when they sell, for medium and large trades because prices move against foreign investors more than domestic investors before trades. The time horizon of trades may be important. Dvorak (2005) shows that domestic investors are better at picking winners over a short horizon and are overall more profitable, but foreign investors are relatively successful at long investment horizons.

Similar research in commodity markets compares the performance of speculators and hedgers. Several papers find speculators profit and hedgers lose. Early research suggested that small traders are unprofitable while large traders are profitable (Houthakker, 1957; Rockwell, 1976).

[2]Choe et al. (1999) find foreign investors did not destabilise Korean stocks during the Asian crisis. Yang (2017) uses a VAR to show that foreign investor sales of Korean stocks in 2008 were not followed by significantly negative returns. While the paper does not analyse investor profitability, it suggests the market impact of foreigners' trades increased and surpassed that of locals during the crisis.

[3]Froot and Ramadorai (2008) demonstrate that institutional cross-border flows are linked to fundamentals.

[4]Foreign investors prefer large over small company stocks in Japan (Kang and Stulz, 1997) and stocks with greater liquidity and those of more international firms in Sweden (Dahlquist and Robertsson, 2001). Investors hold and transact fewer stocks of distant firms or those with different language and/or culture in Finland (Grinblatt and Keloharju, 2001). US liquidity providers demand wider spreads to trade non-US stocks to offset higher adverse selection risk (Bacidore and Sofianos, 2002).

Hartzmark (1987) found hedgers are profitable, and speculators are not, but later Hartzmark (1991) suggests superior hedger performance is due to luck, not information. Phillips and Weiner (1994) demonstrated that large oil companies (classified as hedgers) and Japanese trading houses (speculators) trade profitably within the day but not interday in petroleum forwards. Other types of speculators and dealers trade at a loss both within and across days. Dewally et al. (2013) show that in energy futures, hedgers trade at a loss while speculators trade profitably, particularly those who hold opposite positions to hedgers. They suggest speculator profits are generated by absorbing risk from, or providing liquidity to, hedgers. DeRoon et al. (2000) show that hedgers in commodity and financial futures bring price pressure and thus are likely to demand liquidity.

Fishe and Smith (2012) examine recent disaggregated trader position data and show that hedgers tend to be liquidity suppliers and uninformed, while brokers and funds are informed, and funds demand liquidity. The authors infer that the normal role of hedgers in commodity futures has changed from demanders to suppliers of liquidity. On the other hand, Frino et al. (2016) suggest that large buy trades likely initiated by hedgers are informed in Australian grain futures, an illiquid domestic deliverable market. Cheng and Xiong (2014) claim that traders classified as hedgers in US agricultural commodities also speculate.

3. Futures Markets, Investor Groups and Data

In the following sections, we explain the relevant characteristics of the futures markets selected for analysis, define the investor groups and discuss the data and variable construction.

3.1. Futures Markets for Gold, Platinum, Gasoline and Rubber

The gold, platinum, gasoline and rubber futures markets differ regarding two important characteristics. The first is the homogeneity of the TOCOM futures contract amongst those traded on globally important exchanges. Several futures contracts exist for most commodities. Where a commodity is traded on more than one exchange, each exchange typically uses its own contract specification. An exchange may also trade more than one type of futures contract for a given commodity. Each type of contract contains an exact description of the permitted underlying (or deliverable) physical commodity. Where the globally important futures for a commodity use a common specification of the underlying commodity, we label the contracts as homogeneous. Conversely, where the futures for a commodity contain different specifications of the underlying physical commodity, we call the contracts heterogeneous. In this sub-section, we discuss the homogeneity or heterogeneity of the TOCOM contracts for gold, platinum, gasoline and rubber, as well as other relevant characteristics of the markets. The second important difference between the TOCOM gold, platinum, gasoline and rubber futures is their relative market liquidity. Our model provides a measure of market liquidity, which we explain in Section 5.

Gold futures are homogeneous in that they trade on several exchanges around the world with virtually identical specifications of the underlying commodity. Hauptfleisch et al. (2016) note that the global trade in gold is decentralised across multiple venues. They find that while both the London and New York futures markets contribute to price discovery, New York plays a larger role on average despite its turnover being less than 10 percent of London. TOCOM is a relatively small market for gold futures in international terms, although not insignificant in East Asia[5]. Lucey et al. (2014) find that the London and New York markets dominate returns and volatility, and affect trade in Tokyo, but there is no consistent effect of trade in Tokyo on other markets. Investors treat gold as a financial asset given that investment-related inventories are large relative to the annual consumption for jewellery and industrial processes (O'Connor et al., 2015).

The majority of global trade in platinum futures takes place on two exchanges that trade homogeneous platinum contracts, the New York Mercantile Exchange (NYMEX) and TOCOM[6]. TOCOM was the largest market for platinum by weight of metal until around the time of the global financial crisis. In 2008, 3.5 million kilograms were traded on TOCOM, equivalent to 4.4 times the trade of NYMEX. However, in the first six months of 2018, futures equivalent to around 4.4 million kilograms were traded on NYMEX, about five times that on TOCOM over the same period. Despite the decline in TOCOM volume, the exchange remains an important trading venue for end-users of the metal. Over 40 percent of global platinum production is used in automotive catalytic converters (McDonald and Hunt, 1982; Eller and Sagerer, 2011). Firms that trade platinum for use in the Japanese automotive industry hedge on TOCOM. While both gold and platinum are considered precious metals, gold is sought by investors as a safe haven during periods of uncertainty, while platinum is stockpiled during good economic times for industrial use (Chng and Foster, 2012).

Gasoline contracts trade on several futures exchanges around the world, including TOCOM,

[5]Gold futures trade in Tokyo represented approximately 6 percent and 5 percent of the volume of trade on the Commodity Exchange of New York (COMEX) by weight of metal in 2015 and 2016, respectively.

[6]The most important differences between the NYMEX and TOCOM contracts are their currency of denomination and most active maturity. Far contracts are the most liquid on TOCOM while nearby contracts are the most liquid on NYMEX.

NYMEX and the Intercontinental Exchange (ICE). TOCOM gasoline futures are heterogeneous in that the underlying commodity is a domestic grade of finished regular gasoline that conforms with the Japanese Industrial Standard (JIS) K2202 Grade 2. This differs from the grades of gasoline that underlie the contracts traded on other exchanges[7]. Japan's physical market for gasoline is also separate from the rest of the world. The import of gasoline is virtually non-existent relative to total consumption, as almost all gasoline is domestically refined[8]. Local supply and demand factors may differ from gasoline fundamentals in other countries, implying that TOCOM futures prices may diverge from their overseas counterparts. Local information, such as domestic refinery output, inventory levels and consumption, should be important for investors trading gasoline on TOCOM.

TOCOM and the Singapore Exchange (SGX) have traditionally been the largest and most important markets for the pricing of natural rubber (Meng and Liang, 2013; Chang et al., 2011), while the Shanghai Futures Exchange (SHFE) has risen in prominence in recent years. Several smaller nationally-focussed exchanges also trade rubber futures, including the Multi Commodity Exchange (India), Thailand Futures Exchange and Jakarta Futures Exchange. Futures are based on one of several different grades of natural rubber, including Ribbed Smoked Sheets Number 3 (RSS-3), RSS-4 and Technically Specified Rubber (TSR-20)[9]. TOCOM contracts based on RSS-3 have been traded since 1952[10]. SGX trades RSS-3 and TSR-20. Tan (2015) and Craymer (2016) note that TOCOM RSS-3 contract volumes and liquidity have declined, volatility has increased, and market participants believe prices have become less connected with fundamentals. At the same time, SGX TSR rubber contract volumes have increased substantially. This coincides with an increase in the industrial use of TSR rubber and shift in preference of the industry to hedge with contracts based on TSR rubber[11]. Of the four markets we examine, the number of transactions by commercial participants hedging physical commodity positions is the lowest in rubber. Asia is also the geographic centre of the production and consumption of natural rubber. Thailand, Indonesia and Vietnam are the largest producers of natural rubber,

[7]For example, RBOB (reformulated gasoline blendstock for oxygen blending) and Singapore Mogas contracts trade on NYMEX and ICE.

[8]Gasoline imports represented less than three percent of consumption in 2013 and 2014 according to data in Petroleum Association of Japan (2015).

[9]RSS rubber is rolled into sheets and dried in a smokehouse, while TSR is washed, shredded, granulated under controlled conditions, and dried as a block (International Rubber Study Group, 2018a). TSR is precisely graded based on the rubber's chemical and quality properties, while RSS rubber is graded by visual inspection.

[10]TOCOM recently launched a new contract for TSR-20 on 9 October 2018

[11]Masuda (2018) notes that imports to Japan of TSR rubber surpassed those of RSS rubber in 2002, and by 2017 TSR accounted for 70 percent of imports.

while China is the largest consumer (IHS Markit, 2018). Around 60 percent of natural rubber is used to produce vehicle tyres and tubes (International Rubber Study Group, 2018b).

In summary, we consider TOCOM gold and platinum futures as homogeneous with contracts for gold and platinum on other exchanges, respectively. TOCOM gasoline and rubber futures are heterogeneous.

3.2. Investor Groups

With the introduction of TOCOM's J-GATE trading system in September 2016, brokers are required to classify each trade on the exchange as originating from one of six investor groups: (i) Commercials (denoted in TOCOM documentation as 40), (ii) Prop/Market Makers (5B), (iii) Funds/Investment Trust (5C), (iv) General Investors (5D), (v) Agency (5E), and (vi) Foreign Investors (5F). This investor transaction breakdown is considerably more detailed than those provided many commodity futures exchanges in their publicly available data.

TOCOM's J-GATE classifications are more intuitive and useful for examining information asymmetry among investor groups than the classifications used prior to the introduction of the new trading system[12]. The new classifications attribute trades to the type of investor ordering the transaction, while the old classifications indicated how trades were placed on the exchange.

The six investor groups are defined as follows. Commercials are domestic and foreign entities that transact to hedge physical commodity positions. Most Commercial trades originate from Japanese firms. We abbreviate the group name slightly to "Commercial". Prop/Market Makers are proprietary traders, futures commission merchants (FCMs) and market-making brokers or dealers that have direct access to trade on TOCOM. We call this group "Dealer". Funds/Investment Trusts covers all types of funds managed by financial institutions, which may be active or passive, and includes investment trusts (known as Toshin in Japan), exchange-traded funds (ETFs), mutual funds, hedge funds and Commodity Trade Advisor (CTA) funds. We refer to this group as "Fund". General Investors are domestic individual retail investors who access the markets via on-line and traditional retail broker services. We refer to this group as "Retail". Agency, referred to simply as "Agency", includes financial intermediaries who cannot place their trades directly on TOCOM and access the markets via domestic intermediaries who

[12] Prior to the introduction of J-GATE, investors were classified according to seven groups: (i) commercials with direct access to TOCOM (1A), (ii) commercials without direct access to TOCOM (21), (iii) commercials with access to TOCOM but trading through intermediaries (31), (iv) other commercials (3A), (v) intermediaries (1B), (vi) intermediaries that trade through other intermediaries (32), (vii) individual and institutional investors, and financial institutions (22).

are members of the exchange. This classification may include trades originating from investors that could otherwise be classified under the other groups. Foreign Investors perform similar investment activities to the domestic market participants classified as Prop/Market Makers and Funds/Investment Trusts. We refer to the Foreign Investors category as "Foreign". Note that foreign firms hedging physical positions are included in Commercial. Using our terminology, we have the following six investor groups: Commercial, Dealer, Fund, Retail, Agency, and Foreign.

3.3. Data and Trade Ratio Construction

We obtained daily futures close price and transaction data for gold, platinum, gasoline and rubber from TOCOM[13]. Our sample period runs from 20 September 2016 to 28 February 2018. The beginning of the sample corresponds with the introduction of TOCOM's J-GATE trading system, under which all trades are classified as originating from the six investor groups described in Section 3.2[14].

Figure 1 shows the price series. Prices are denominated in Japanese yen per gram for gold and platinum, yen per kilolitre for gasoline and yen per kilogram for rubber. The prices of the four commodities display different behaviour over the sample period. However, a common feature is a rise in prices at the end of 2016, corresponding with a substantial depreciation in the Japanese yen from around 100 to the US dollar to 117. We calculate returns over the trading day, which runs from the start of the night session to the end of the following day session[15].

Contract months are all even months of the year for gold and platinum, and six consecutive months for gasoline and rubber. Six non-expired contracts exist at any time. An important characteristic of trade on TOCOM is that the farthest contract is the most liquid and actively transacted while the near contract is illiquid. This contrasts with most other futures exchanges where trade is primarily in the near or second-near contracts. We use prices for the farthest contract in each commodity to calculate returns.

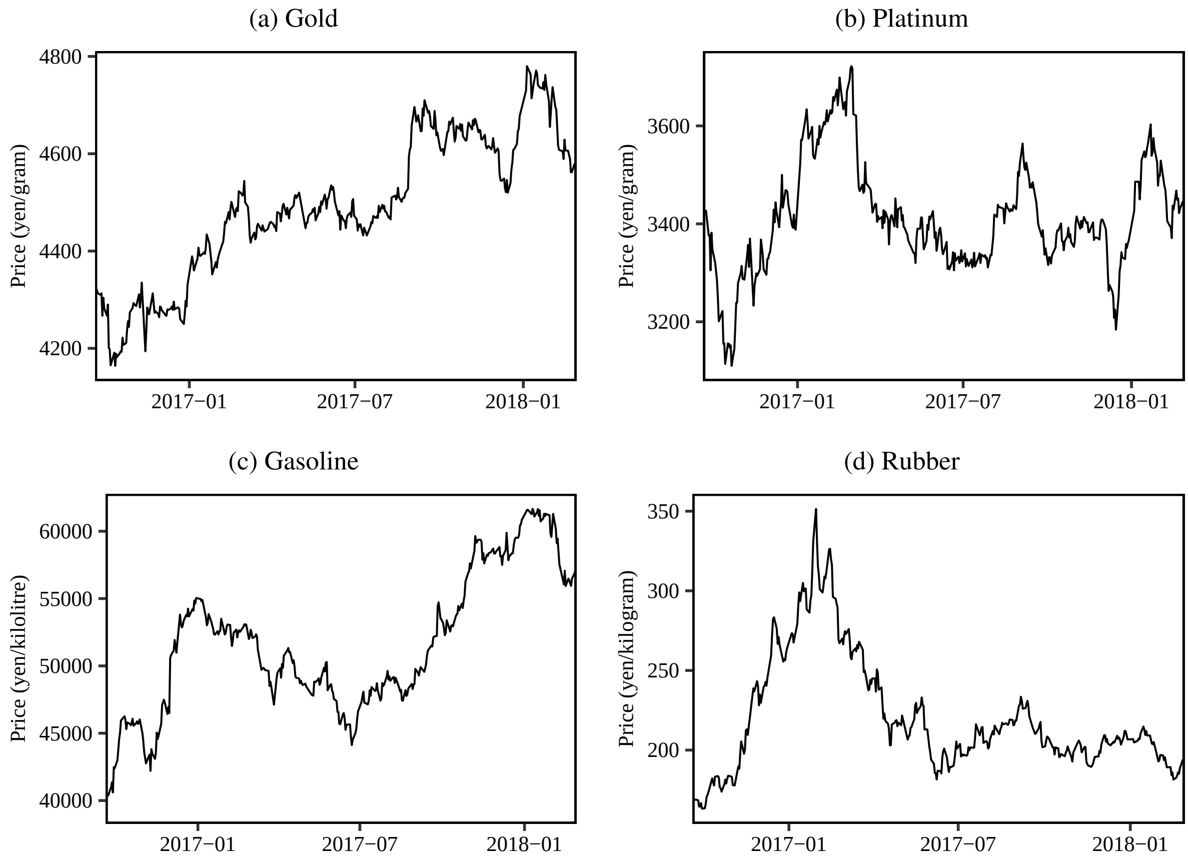
The transaction data contains the number of contracts for each commodity bought and sold on each trading day by each investor group. TOCOM aggregates investor group transactions over all six non-expired contract maturities. While we would prefer to measure transactions in

[13]The price data is available from `https://www.tocom.or.jp/historical/download.html`. We obtained the transaction data directly from TOCOM to get a longer sample than is publicly available from their website.

[14]As the investor group classifications used in J-GATE differ from those used under the previous trading system, we are limited to using data beginning in September 2016.

[15]TOCOM runs its night session from 16:30 to 05:30 Japan Standard Time (JST) for gold, platinum and gasoline, and 16:30 to 19:00 JST for rubber. The day session begins at 8:45 JST and ends at 15:15 JST.

Figure 1: Daily Futures Prices



the farthest contract only, the data is reasonable for our purposes as transactions in the farthest contract constitute the majority of total volume over all non-expired maturities.

Table 1 provides summary statistics for transactions and returns. Across the investor groups, mean and median daily transaction volumes are the greatest for gold followed by platinum, then rubber and lowest for gasoline[16]. The two homogeneous markets have substantially higher transactions than the two heterogeneous markets. Retail investors are relatively large transactors in all four markets. Commercial investors are among the largest traders in gold, platinum and gasoline. Dealers are among the largest participants in gold, and Foreign investors are the largest participants in rubber. Funds have relatively small transaction volumes in each market. Dealers' mean buys and sells are approximately balanced in all four markets, while the other investor groups are usually either net buyers or sellers in each market over the sample. For example, Commercials are, on average, net sellers in gold, platinum and rubber, suggesting the majority are hedging future sales of the commodity. Retail investors are net buyers in the same

[16]The total one-sided transaction volumes in the sample are approximately 31.6 million for gold, 19.8 million for platinum, 7.8 million for rubber and 3.3 million for gasoline.

markets. The transactions series are leptokurtic, and most are positively skewed.

The commodity futures returns series exhibit the stylised properties of financial returns. Standard deviation is lowest for gold, followed by platinum, then gasoline and highest for rubber. The homogeneous contracts have lower market risk than the heterogeneous contracts.

Table 1: Summary Statistics for Trades and Returns

	Commercial		Dealer		Fund		Retail		Agency		Foreign		Return
	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	
(a) Gold													
Mean	6248	23876	13382	14774	601	35	50212	40898	6745	6023	12017	3682	0.017
Median	6292	21724	12602	13938	459	25	47802	41257	6209	6007	13008	2539	0.022
Maximum	11991	49951	28053	25434	1201	99	82821	63654	11509	9009	27273	15317	1.480
Minimum	326	4193	5569	4107	336	12	24505	20954	3422	3311	1337	188	-2.465
Std. Dev.	2986	10375	5807	5646	251	20	13562	9778	1997	1322	5969	3248	0.474
Skewness	0.03	0.36	0.94	0.13	0.84	1.58	0.38	0.08	0.73	0.15	-0.07	1.44	-0.490
Kurtosis	2.35	2.34	3.00	1.88	2.01	4.81	2.16	2.38	2.53	2.47	2.11	4.78	5.776
(b) Platinum													
Mean	4055	26599	3627	4136	282	2	37895	16615	5056	1678	5027	6991	0.006
Median	3710	25953	3640	3266	266	0	38520	16938	5266	1697	3768	7157	0.000
Maximum	8140	35920	7781	10167	476	42	53752	23572	6383	2544	15705	19301	4.014
Minimum	1083	14910	700	1003	224	0	20792	6435	2625	816	1093	162	-3.204
Std. Dev.	1744	6206	1447	2666	51	8	7965	3810	972	335	3486	4071	0.862
Skewness	0.67	-0.28	0.02	0.71	1.66	4.02	-0.09	-0.45	-0.91	-0.37	0.87	0.79	0.185
Kurtosis	2.61	1.76	3.03	2.30	4.59	18.56	2.40	2.51	2.77	2.68	2.72	3.87	4.322
(c) Gasoline													
Mean	4344	3574	1577	1756	7	42	2649	2436	301	257	497	1296	0.111
Median	4301	3593	1479	1577	0	28	2619	2393	283	247	203	1502	0.170
Maximum	6334	5777	2859	3114	65	171	3749	3454	560	503	2435	2356	8.774
Minimum	1791	1567	676	410	0	23	1436	1269	94	131	20	48	-4.157
Std. Dev.	1192	1082	492	720	13	30	557	365	118	62	588	671	1.245
Skewness	-0.15	0.10	0.66	0.13	1.69	2.52	0.14	0.46	0.43	1.11	1.47	-0.49	1.070
Kurtosis	1.85	2.20	2.80	1.75	4.69	9.32	2.02	3.07	2.35	4.72	4.20	1.84	9.886
(d) Rubber													
Mean	2254	4195	1676	1675	24	5	8538	5798	792	1229	8575	8993	0.072
Median	2332	4029	1526	1515	14	0	8434	4782	793	1063	8002	8076	0.061
Maximum	4587	9615	4435	4472	122	35	13780	12327	1130	2684	19430	21464	6.969
Minimum	336	1337	620	326	9	0	2529	2672	300	517	1835	2016	-6.943
Std. Dev.	1174	1585	660	690	22	6	3055	2626	175	456	3598	3873	2.297
Skewness	0.17	0.88	1.26	1.10	2.56	1.65	0.01	0.94	-0.40	1.13	0.79	0.98	-0.012
Kurtosis	1.91	4.04	5.04	4.40	9.56	6.13	1.92	2.44	2.77	3.61	3.64	3.87	3.747

Notes:
1. Buy and sell transactions are expressed as number of futures contracts.
2. Returns are daily percent changes.

We calculate the daily trade ratio, $x_{g,t}$, for each investor group, $g = 1, \ldots, 6$, at time t:

$$x_{g,t} = \frac{B^{\star}_{g,t} - S^{\star}_{g,t}}{B^{\star}_{g,t} + S^{\star}_{g,t}} \tag{1}$$

where $B^{\star}_{g,t}$ and $S^{\star}_{g,t}$ represent the number of futures contracts bought and sold by investor group g at time t, respectively. The trade ratio series are stationary and range between minus one and one. A positive (negative) trade ratio shows the investor group bought (sold) more contracts than it sold (bought) during the trading day. The trade ratio is a relative indicator of trade direction and does not contain information about absolute transaction volumes.

Figure 2: Trade Ratios

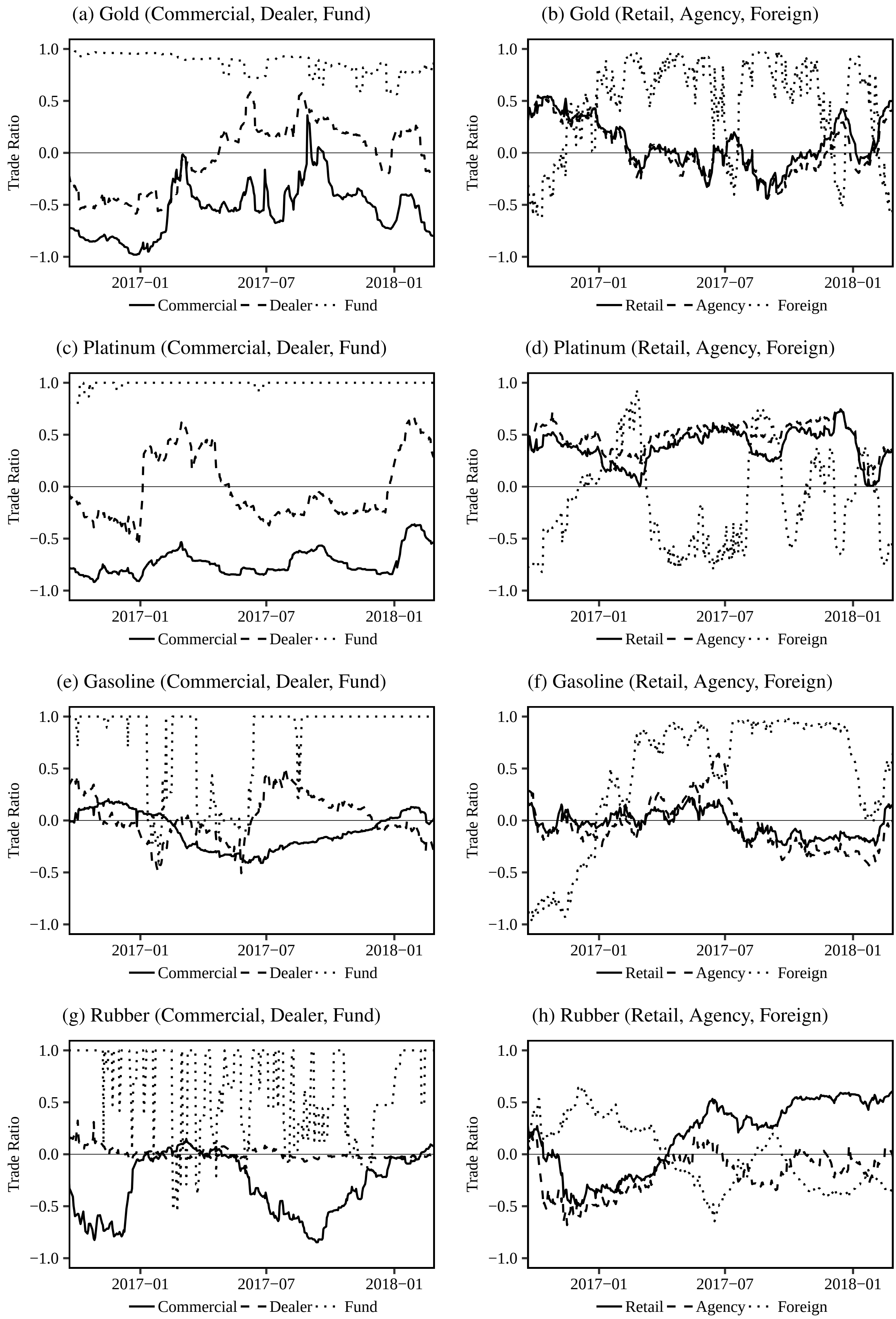


Figure 2 shows the trade ratios. Commercials' trade ratios are mostly negative, consistent with hedging physical commodity sales. Dealer trade ratios in the metals are correlated with those of Commercials, but are less negative. Funds have predominantly high trade ratios, potentially because of a preponderance of long-only investors in this group. The Retail and Agency trade ratios are highly correlated in all four markets, which may indicate that a large part of Agency transactions come from retail brokers without direct access to TOCOM. Retail investors' trades are negatively correlated with those of Commercials and Dealers in gold and platinum, and negatively correlated with Foreigners in gold, platinum and rubber. Foreign trades are negatively correlated with those of Commercials in the gasoline market.

4. Modelling the Information Content of Trades

The following subsections describe the model we use to determine the influence of investor groups' trading on the efficient price and to differentiate between trade-related and non-trade-related information.

4.1. SVAR Model of Transactions and Returns

We adapt the structural bivariate VAR model proposed by Hasbrouck (1991a,b) of orderflow and price revisions to examine the information content of the six investor groups' trades in each commodity futures market. Our multivariate model can be expressed in vector form as:

$$BY_t = \Phi_0 + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \cdots + \epsilon_t \tag{2}$$

where: $Y_t = \begin{bmatrix} X_t \\ r_t \end{bmatrix}$, $X_t = \begin{bmatrix} x_{1,t} \\ x_{2,t} \\ x_{3,t} \\ x_{4,t} \\ x_{5,t} \\ x_{6,t} \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & -b_1 \\ 0 & 1 & 0 & 0 & 0 & 0 & -b_2 \\ 0 & 0 & 1 & 0 & 0 & 0 & -b_3 \\ 0 & 0 & 0 & 1 & 0 & 0 & -b_4 \\ 0 & 0 & 0 & 0 & 1 & 0 & -b_5 \\ 0 & 0 & 0 & 0 & 0 & 1 & -b_6 \\ -c_1 & -c_2 & -c_3 & -c_4 & -c_5 & -c_6 & 1 \end{bmatrix}$.

In our model, Y_t contains the trade information, X_t, for each of the six investor groups and the futures mid-price return, r_t. X_t contains the trade ratios for the six investor groups, $x_{g,t}$, where $g = 1, \ldots, 6$, corresponding to the investor groups Commercial, Dealer, Fund, Retail, Agency and Foreign, respectively. The Φ_i are 7×7 coefficient matrices, where i represents the number of lags included in the VAR.

Contemporaneous trade ratios and returns enter the system as explanatory variables. There are contemporaneous relationships between trade ratios and returns, and returns and trade ratios, but not between the trade ratios, which constitute the restrictions to identify the model. The b_g are the coefficients for the contemporaneous returns variable in the six trade ratio relationships. The c_g are the coefficients for the six contemporaneous trade ratio terms that appear in the returns equation. The first six rows of the system represent the relationship between the trade ratio, its lags and the contemporaneous return for each investor group. The innovations include unexpected trading activity. The final row is the relationship between return, as the dependent variable, and its lags plus the contemporaneous trade ratio for each investor group.

The number of lags to be included in the SVAR model for each commodity was determined using the Akaike Information Criterion (AIC). Lags included in the models are as follows: for gold two lags, platinum three, gasoline two and rubber one. Each model was estimated using maximum likelihood. The contemporaneous coefficient estimates are provided in Tables A.3 to A.6 in Appendix A.

4.2. The Efficient Price and Mispricing

Hasbrouck (1991b) provides a method to decompose the variance of the permanent component of a security's price into trade- and non-trade-related components. The permanent component of a securities price is interpreted as the efficient price reflecting the fundamental valuation of the security. Only where trades influence the permanent component of price do investors influence the efficient price. The trade-related part of the permanent component may be interpreted as the private information incorporated in the security's price through unexpected trades. The non-trade-related part of the permanent component reflects public information. We modify this approach to estimate the influence trades on the efficient price and asymmetry in the information content of the trades of the six investor groups.

The price of a security, p_t, may be decomposed into the efficient price, m_t, and mispricing, s_t:

$$p_t = m_t + s_t \tag{3}$$

where m_t follows a random walk process, s_t is a mean-zero covariance stationary process, and $\lim_{h\to\infty} E\left(s_{t+h}\right) = 0$.

The permanent component of price, or efficient price, can be modelled as:

$$m_t = m_{t-1} + \omega_t \tag{4}$$

where $\omega_t \sim N\left(0, \sigma^2_\omega\right)$, and $E\left(\omega_t\, \omega_s\right) = 0$ for $t \neq s$.

The efficient price, m_t, is driven by the previous period's efficient price and an innovation that reflects new fundamental information, ω_t, which is incorporated in the efficient price at time t. The efficient price innovation has a permanent influence on the security price, while the mispricing shock, s_t, has only a temporary effect. The s_t component represents transitory effects on the security's price arising from non-information based microstructure effects, liquidity provision and noise trading. The variance of the information innovation, σ^2_ω, measures the variation in the permanent component of the price.

The SVAR shown in equation (2) can be inverted to the Vector Moving Average (VMA) representation:

$$Y_t = \left(I + \theta_1 L + \theta_2 L^2 + \theta_3 L^3 + \ldots\right) \epsilon_t = \theta\left(L\right) \epsilon_t \tag{5}$$

where L is the lag operator, the θ_i are 7×7 matrices of coefficients, and ϵ_t is a white noise error process, with $E\left(\epsilon_t\right) = 0$ and $Var\left(\epsilon_t\right) = \Omega$.

The variance of a shock to the permanent component of the security's price is estimated from the VMA representation in (5) as:

$$\sigma^2_\omega = \left[\theta\left(1\right)\right]_7 \Omega \left[\theta\left(1\right)\right]'_7 \tag{6}$$

where $\left[\theta\left(1\right)\right]_7$ denotes the seventh row of $\left[\theta\left(1\right)\right]$ that corresponds to the returns relationship, and $\left[\theta\left(1\right)\right] = I + \theta_1 + \theta_2 + \ldots$.

The variance of the trade-related component for an investor group, g, is:

$$\sigma^2_{\omega,x_g} = \left[\theta^\star\left(1\right)\right]_7 \Omega \left[\theta^\star\left(1\right)\right]'_7 \tag{7}$$

where $\theta^\star$ represents θ from the VMA with the coefficients related to all other investor groups and the coefficients related to returns set to zero. Similarly, the variance of the non-trade-related component, $\sigma^2_{\omega,r}$, is calculated by setting $\theta^\star$ to the θ from the VMA with zeros for the coefficients related to all investor groups' trades.

We can obtain the variance due to the trade-related, σ^2_{ω,x_g}, and non-trade-related, $\sigma^2_{\omega,r}$, components using this procedure, and express these relative to the total variance of the permanent component, σ_ω^2. The relative trade-related variance for an investor group provides a measure of the relative influence of that group's trades on the efficient price. The relative non-trade-related variance gives a measure of the influence of public information on the efficient price.

5. Empirical Results

We present the results from the SVAR model for each market in Section 5.1, discuss the informed and uninformed investors in each commodity in Section 5.2 and compare the information shares by investor type across the four commodities in light of contract homogeneity and market liquidity in Section 5.3.

Table 2: Empirical Results

	Gold	Platinum	Gasoline	Rubber
(a) Long-Run Price Impact of Trade (at 30 Days)				
Commercial	-0.04	-0.29	-0.43	-0.79
Dealer	-0.02	-0.15	-0.94	1.09
Fund	0.06	0.20	0.14	1.13
Retail	0.37	-0.31	0.75	-1.01
Agency	0.04	-0.13	0.26	-0.84
Foreign	0.17	-0.26	0.25	0.55
Return	-0.04	0.29	0.16	2.57
(b) Variance Decomposition of the Efficient Price (% Share at 30 Days)				
Commercial	39.48	27.55	4.86	0.29
Dealer	8.06	0.43	17.79	1.25
Fund	5.80	29.16	4.08	27.70
Retail	0.41	6.36	57.94	17.50
Agency	0.36	3.13	3.97	5.65
Foreign	45.64	14.90	7.98	0.28
Return	0.24	18.47	3.38	47.34
Share by trades	99.76	81.53	96.62	52.66
(c) Forecast Error Variance Decomposition (% Share at 30 Days)				
Commercial	0.88	1.91	8.08	1.59
Dealer	0.71	0.32	20.14	2.80
Fund	0.70	0.65	0.43	32.02
Retail	89.23	86.67	11.42	5.16
Agency	2.21	2.58	3.41	8.07
Foreign	1.42	1.95	15.73	0.83
Return	4.85	5.92	40.79	49.53

5.1. SVAR Results

We present the results of estimating the SVAR model for each commodity in Table 2. Panel (a) provides the long-run price impact of trade for each investor group, which is defined as the sum of the coefficients in $\theta^{\star}$ for that group multiplied by a shock to the group's trade ratio equation. This is equivalent to the cumulative impulse response function (CIRF) of return to a one standard deviation unanticipated increase in an investor group's trade ratio, evaluated at 30 trading days ahead. We assume 30 trading days is a sufficient period for the short-term influences of trade shocks on return to reverse out. In the long run, the mean-zero temporary components of price would be expected to offset each other, leaving the permanent influence of unexpected trades. A positive long-run price impact of trade indicates an investor group may be informed, as the market price increases (decreases) following an unanticipated increase (decrease) in the group's trade ratio. A negative long-run price impact may suggest the group is a liquidity provider. Plots of the CIRFs are provided in Figures B.3 to B.6 of Appendix B. Commercials' long-run price impact of trade is negative in each market, consistent with the motivation of their trades being to hedge price risk and with the conclusion of Fishe and Smith (2012) that hedgers are liquidity providers. Funds have a positive long-run price impact in each market, while other groups' long-run price impacts are both positive and negative. The cumulative response of return to a shock in return is also shown in Panel (a) of Table 2. Unanticipated return shocks have a relatively small long-run impact on price compared with unexpected trades in gold and gasoline. In the platinum market, return shocks have a similar long-run impact in absolute terms as Commercial, Retail and Foreign investors. However, return shocks have a much greater absolute long-run impact than trade shocks in the rubber market.

The long-run price impact of trade can be interpreted as a measure of market liquidity. Unanticipated trades will have a relatively large (small) long-run price impact in markets that are less (more) liquid. We discuss this further in Section 5.3.

Panel (b) gives the variance decomposition of the efficient price, m_t in equation (4), for shocks in the trade ratios of each investor group and returns. The variance decomposition of the efficient price is stated as a percentage share and provides an estimate of the relative information content of each investor group's trades. Two or three investor groups in each market account for the majority of the trade-related variance in the efficient price. Added together, the share for all investor groups represents the share of the trade-related component, interpreted as private information. The variance decomposition of the efficient price for return shows the share of the non-trade-related component, which we interpret as public information. Trades are responsible for almost all of the variance decomposition of the efficient price in the gold and gasoline markets, the majority in platinum but only around half for the rubber market where public information is relatively important.

Panel (c) shows the forecast error variance decomposition for the price, p_t, which we include for comparison with the variance decomposition of the efficient price. The forecast error variance decomposition reflects the influence of both the permanent, m_t, and transitory, s_t, components of price, and does not provide a means to detect information asymmetry. Larger coefficients on near-term forecast error variances mean that investors with a relatively large short-term influence on price will have a higher share of the forecast error variance decomposition. Retail investors dominate the forecast error variance decomposition in both gold and platinum, while Dealers have the largest share in gasoline and Funds in rubber. Return innovations have negligible influence over price according to the forecast error variance decompositions for the homogeneous markets, gold and platinum, and substantial influence over price in the heterogeneous markets, gasoline and rubber.

5.2. Informed and Uninformed Investors in Each Market

Informed and uninformed investors can be differentiated by looking at both the variance decomposition of the efficient price and the sign of the long-run price impact of trade. Informed investors' trades contain fundamental information, ω_t, that influences the efficient price, m_t. Thus their trades will have a positive long-run price impact of trade, and their share of the variance decomposition of the efficient price will be relatively large. Uninformed investors, such as noise traders, only add to mispricing, s_t, so their share of the variance of the efficient price is expected to be small. We discuss the information asymmetries revealed by the model for each commodity in Sections 5.2.1 to 5.2.4.

5.2.1. Gold Futures

Foreign investors, the fourth largest players in the gold market by transactions, are informed. Their trades are responsible for a large share of the variance of the efficient price and have a positive long-run price impact. While Commercials' trades also have a relatively large influence over the efficient price, the group is not informed as their long-run price impact of trade is negative, albeit with a small magnitude. Commercials appear to be supplying liquidity[17]. The

[17]Other potential explanations for Commercials' small market impact may be that their hedging trades are efficiently placed such that they create little price pressure, that some of their hedges have been profitable, or that

remaining investor groups have little influence over the efficient price. Retail investors, the largest players in the gold market by transactions, have the largest long-run price impact and account for almost all of the forecast error variance decomposition. However, their trades have no influence over the efficient price. Retail investors have a substantial short-run market impact, and accordingly, they are likely to be noise traders. Dealers barely leave footprints in the gold market. They are the third-largest players, but their trades have a relatively small long-run impact on price and account for a small share in the variance of the efficient price.

5.2.2. Platinum Futures

Funds are informed in platinum. Their trades have the largest influence over the efficient price and a positive long-run price impact. Although Commercials' trades have a similar influence over the efficient price, their long-run price impact is negative. Commercials are not informed, and as in the gold market, appear to be liquidity suppliers. Foreign investors are not informed. Although their trades are responsible for the third-largest share of variation in the efficient price, they have a negative long-run price impact. The remaining investor groups' trades account for small shares variation in the efficient price and have negative price impact. Retail investors, the largest players by trades, are uninformed but create substantial temporary price pressure. They have a large influence over the market price, the largest negative long-run price impact of trade, but only a small influence over the efficient price.

5.2.3. Gasoline Futures

Retail investors are informed in the gasoline market. Their trades have a positive long-run price impact and account for more than half of the variance of the efficient price. They are the second-largest players in the market by number of contracts traded, and have the second-largest share of the forecast error variance decomposition. The remaining investor groups are uninformed. Dealers' trades have the second largest influence on the efficient price, while their long-run price impact is both negative and large. Commercials are the largest players in the market. However, their information share is small, and they have a negative long-run price impact of trade. Foreign investors have only a short-run influence on price. Returns account for around 40 percent of the forecast error variance decomposition, but just over three percent of the efficient price variance. Public information does not have an important role in gasoline.

some Commercials also place profitable speculative trades, as suggested by Cheng and Xiong (2014).

5.2.4. Rubber Futures

Funds are informed investors in the rubber market as their trades have a positive long-run price impact and the largest information share. They are relatively small traders by average daily volume and have a particularly volatile trade ratio. Funds' trades also account for a large share of the forecast error variance, suggesting their active trading style exerts substantial short-run pressure on the market price. Foreign investors are the largest players in rubber, but their trades have almost no influence on the efficient price. Retail investors are the second-largest players in rubber, and their trades have the second-greatest influence over the efficient price. However, their long-run price impact is negative, implying their trading is uninformed. Commercial, Dealer, and Agency investors are also uninformed. Trade and non-trade-related innovations have approximately equal influence on the efficient price of rubber. Public information is important in this market. The long-run price impact of trade indicates rubber is the least liquid of the four markets. The reason for the relatively small trade-related component in comparison with the other commodity futures may be that low liquidity in the rubber market discourages participation by informed traders.

5.3. Information Shares, Contract Homogeneity and Market Liquidity

We compare our results for the four commodity futures across two dimensions, contract homogeneity (refer to the discussion in Section 3.1) and market liquidity.

The TOCOM gold and platinum contracts are homogeneous, as corresponding contracts on other exchanges are based on virtually the same underlying commodity. The global markets for gold and platinum differ in that trade in gold is decentralised over multiple exchanges around the world while trade in platinum is concentrated on TOCOM and NYMEX. The homogeneous contracts are for international commodities. The gasoline and rubber contracts are heterogeneous as there exist important corresponding contracts that are based on different grades of the underlying commodity. TOCOM gasoline futures are based on a Japanese domestic commodity that differs from the types of gasoline underlying the contracts traded on foreign markets. The grade underlying the TOCOM rubber contract is one of several traded on exchanges in Asia. The heterogeneous contracts are for local or regional commodities.

The long-run price impact of trade (Table 2 Panel (a)) indicates that gold is the most liquid market. Platinum is less liquid than gold, but not by a large degree. Most investor groups have a slightly higher absolute market impact in platinum than in gold. Gasoline is noticeably less liquid than platinum, with most groups having a substantially larger absolute market impact. Rubber is demonstrably illiquid compared with the other markets. Interestingly, rubber is less liquid than gasoline despite its greater average daily trading volume and shorter trading hours. Overall, the two homogeneous contracts are relatively liquid, and the two heterogeneous contracts are relatively illiquid.

Table 2 Panel (b) shows that Foreign investors have larger information shares for the homogeneous liquid contracts than for the heterogeneous illiquid contracts. In contrast, Retail investors have larger information shares for the heterogeneous illiquid contracts than for the homogeneous liquid contracts. These results are comparable with the findings in equity markets that suggest foreigners prefer more international and liquid stocks (Dahlquist and Robertsson, 2001), foreign investors prefer larger firms (Kang and Stulz, 1997), and domestic investors prefer more local stocks (Grinblatt and Keloharju, 2001). Our results are consistent with the interpretation that Foreigners may have an advantage in global information that is likely to be of more importance for the more international homogeneous futures contracts. Retail investors may have an advantage in local information that is likely to be useful for trading the more local or regional heterogeneous contracts. Foreigners are mostly institutional investors and are likely to prefer the more liquid homogeneous contracts in which they may make large transactions more easily. Price slippage on trades may be a problem for Foreign investors, as observed by Choe et al. (2005) for stocks. Retail investors are typically small traders, so the relative illiquidity of the heterogeneous commodities is not likely to be a barrier to their participation.

Commercial investors have negative long-run price impacts of trade in all four futures markets. Their information share is relatively large in the homogeneous liquid contracts and small in the heterogeneous illiquid contracts. Our results suggest that Commercials' trades are not profitable in the long-run, consistent with commodities market research that has found hedgers' trading is not profitable, such as Dewally et al. (2013). The results for the homogeneous markets imply that Commercials may be supplying liquidity, which would be broadly consistent with the findings of Fishe and Smith (2012). Commercial investors may have greater incentive to hedge in more liquid commodities, where their market price impact, and thus their hedge costs, are lower.

Funds have larger information shares in platinum, a homogeneous liquid contract, and rubber, a heterogeneous illiquid contract. They also trade profitably in both markets, which are also markets in which public information has some importance. Lower liquidity may not be a substantial disincentive to Funds as they trade in relatively low average daily volumes. As domestic investors, Funds may have better access to local information than foreign investors, which is likely to be an advantage in trading heterogeneous contracts. As professional investors, they may also have access to global information. These characteristics may explain their ability to influence the efficient price in both a homogeneous and a heterogeneous market.

6. Conclusion

We present evidence on the asymmetric information content of the trades of six investor groups transacting in the gold, platinum, gasoline and rubber futures markets on TOCOM. Our research makes three main contributions to the literature. First, we determine which investor groups are informed and uninformed, and thus which types of investor generate profits from their trading over the long run. Second, we compare our results across four commodity futures with different contract homogeneity and market liquidity characteristics to shed light on the reasons that lie behind differences in the information content of investor groups' trades. Third, we exploit new data from TOCOM that matches investors with like motivations for trading with their transactions.

We find that the efficient price in the gold, platinum and gasoline markets is mainly influenced by trade-related innovations (private information). In the rubber market, private and public information have an approximately equal influence on the efficient price. Foreign investors have the greatest influence over the efficient price in the gold market, Retail investors in the gasoline market, and Funds in the platinum and rubber markets. As informed investors, these groups are expected to be profitable traders over the long run. Differences in the relative influence of investor groups over commodity futures are likely to reflect the degree of contract homogeneity and associated market liquidity. Foreign (Retail) investors have larger information shares for the homogeneous liquid (heterogeneous illiquid) contracts than for the heterogeneous illiquid (homogeneous liquid) contracts.

Our findings have three main implications for practitioners. First, investors are keen to know who are the informed and uninformed traders. We demonstrate this for traders aggregated to six groups, within which traders have a similar motivation for trading. Identifying informed traders is likely to influence the behaviour of the other traders in the market. Second, our analysis offers insights for commodity futures exchanges about market design. Homogeneous liquid futures are likely to present an attractive opportunity for foreign investors to trade where they have an advantage in global information, while small domestic investors may trade at an informational disadvantage. On the other hand, a heterogeneous contract is likely to favour small domestic investors and increase their incentive to trade on the exchange, despite being relatively less liquid. However, heterogeneity may put foreign investors at an information disadvantage and constitute a barrier to their participation in the market. Further, the lower level of liquidity associated with a heterogeneous contract may be a barrier to large investor participation, and to arbitrage across international markets. A balanced approach to the trade-off regarding contract homogeneity versus heterogeneity, and associated market liquidity, is required. Third, questions about speculative activity and commodity futures market stability require regulators to have knowledge regarding which investors may be stabilising or destabilising, which investors may be liquidity providers and how price risk is transferred between different types of traders. Our approach provides a method to analyse and monitor commodity futures trades and returns in order to answer these questions.

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Appendix A. Contemporaneous Effects

Tables A.3 to A.6 contain the contemporaneous coefficients, the b_g and c_g for $g = 1, \ldots, 6$, from the SVAR model of equation (4) for each commodity. The return relationship, labelled Eq.7, refers to the last row of the model in which return is a function of the contemporaneous trade ratios of each investor group and lagged values of returns. The estimates are the coefficients of the contemporaneous trade ratio terms for each investor group, c_g. Our prior is that the investor group trades generally have both a contemporaneous and lagged influence on return. All trade ratio contemporaneous coefficients are significant in the model for gold, the coefficients for all groups except Funds are significant in platinum and gasoline, while the coefficients on Fund, Retail and Agency are significant in the rubber market. In each market, there are both positive and negative relationships between contemporaneous return and the trade ratios. A priori, return may or may not have a contemporaneous relationship with each trade ratio in the relationships denoted EQ.1 to Eq.6 for each market. We find significant estimates for the contemporaneous return coefficient, b_g, for each investor group in the gold market, for all except Retail in platinum, for Dealer, Retail and Agency in gasoline, and for none of the investor groups in the rubber market.

Table A.3: Contemporaneous Coefficients for Gold

	Dependent variable	Explanatory variable	Coefficient	Standard Error	P-value
Eq.1	Commercial	Return	0.035***	0.006	0.000
Eq.2	Dealer	Return	0.036***	0.004	0.000
Eq.3	Fund	Return	-0.008*	0.004	0.090
Eq.4	Retail	Return	-0.290**	0.115	0.012
Eq.5	Agency	Return	-0.066***	0.004	0.000
Eq.6	Foreign	Return	0.199***	0.016	0.000
Eq.7	Return	Commercial	14.682***	1.330	0.000
		Dealer	11.605***	1.595	0.000
		Fund	3.326***	1.432	0.020
		Retail	64.024***	2.567	0.000
		Agency	-35.243***	2.324	0.000
		Foreign	4.390***	0.469	0.000

Note: Significant at 1% shown by ***, at 5% shown by ** and at 10% shown by *.

Table A.4: Contemporaneous Coefficients for Platinum

	Dependent variable	Explanatory variable	Coefficient	Standard Error	P-value
Eq.1	Commercial	Return	0.007***	0.001	0.000
Eq.2	Dealer	Return	0.024***	0.003	0.000
Eq.3	Fund	Return	0.002*	0.001	0.076
Eq.4	Retail	Return	0.049	0.051	0.334
Eq.5	Agency	Return	-0.018***	0.003	0.000
Eq.6	Foreign	Return	0.077***	0.012	0.000
Eq.7	Return	Commercial	-10.750***	3.763	0.004
		Dealer	-4.216***	1.321	0.001
		Fund	-1.668	3.639	0.647
		Retail	-67.258***	3.997	0.000
		Agency	23.450***	2.958	0.000
		Foreign	-5.247***	0.675	0.000

Note: Significant at 1% shown by ***, at 5% shown by ** and at 10% shown by *.

Table A.5: Contemporaneous Coefficients for Gasoline

	Dependent variable	Explanatory variable	Coefficient	Standard Error	P-value
Eq.1	Commercial	Return	-0.002	0.001	0.244
Eq.2	Dealer	Return	-0.007*	0.004	0.082
Eq.3	Fund	Return	0.001	0.008	0.880
Eq.4	Retail	Return	-0.019***	0.002	0.000
Eq.5	Agency	Return	-0.013***	0.002	0.000
Eq.6	Foreign	Return	-0.001	0.005	0.859
Eq.7	Return	Commercial	23.989***	4.088	0.000
		Dealer	16.751***	2.156	0.000
		Fund	0.334	0.543	0.539
		Retail	18.396***	2.410	0.000
		Agency	-7.791***	1.907	0.000
		Foreign	10.713***	1.435	0.000

Note: Significant at 1% shown by ***, at 5% shown by ** and at 10% shown by *.

Table A.6: Contemporaneous Coefficients for Rubber

	Dependent variable	Explanatory variable	Coefficient	Standard Error	P-value
Eq.1	Commercial	Return	0.000	0.002	0.835
Eq.2	Dealer	Return	0.000	0.001	0.909
Eq.3	Fund	Return	0.004	0.040	0.912
Eq.4	Retail	Return	-0.002	0.002	0.292
Eq.5	Agency	Return	-0.003	0.004	0.422
Eq.6	Foreign	Return	0.003	0.002	0.107
Eq.7	Return	Commercial	-3.732	2.305	0.106
		Dealer	-1.383	3.225	0.668
		Fund	3.260***	0.731	0.000
		Retail	-11.326***	3.100	0.000
		Agency	-8.696***	2.167	0.000
		Foreign	-3.075	1.940	0.113

Note: Significant at 1% shown by ***, at 5% shown by ** and at 10% shown by *.

Appendix B. Cumulative Impulse Response Functions

Figures B.3 to B.6 provide the CIRFs for gold, platinum, gasoline and rubber, respectively. Panels (a) to (f) in each figure show the cumulative response of return to a one standard deviation shock in trade ratio of each investor group. The long-run price impact of trade shown in panel (a) of Table 2 corresponds with the value of the CIRF at 30 days. The dashed lines indicate bootstrapped two standard deviation confidence intervals either side of each CIRF, produced using 100 iterations.

Figure B.3: Cumulative Impulse Response Functions of Return for Gold

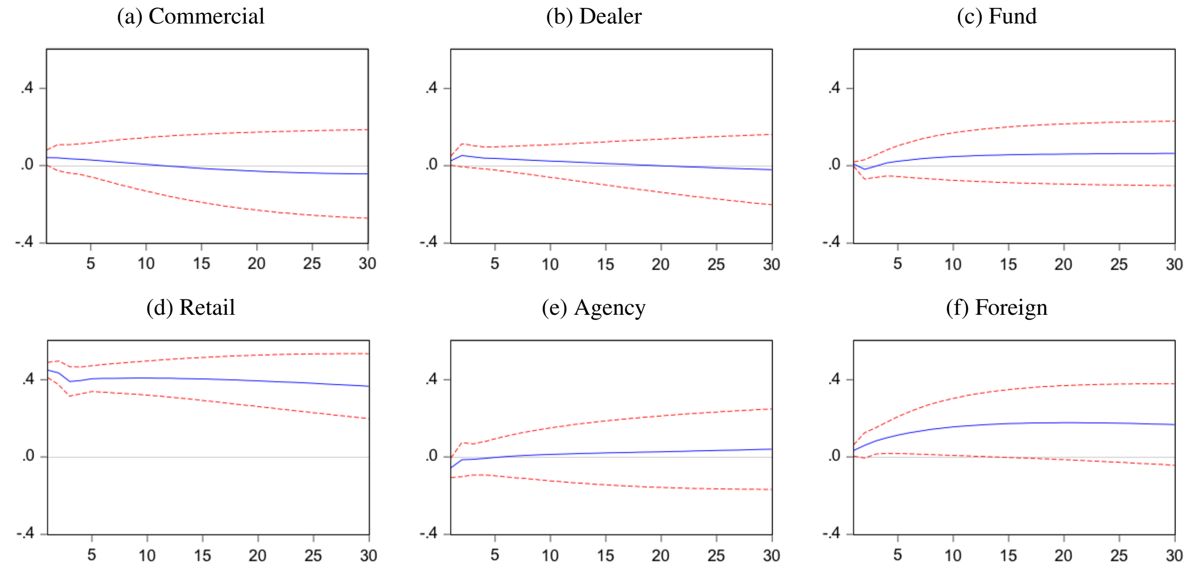

Figure B.4: Cumulative Impulse Response Functions of Return for Platinum

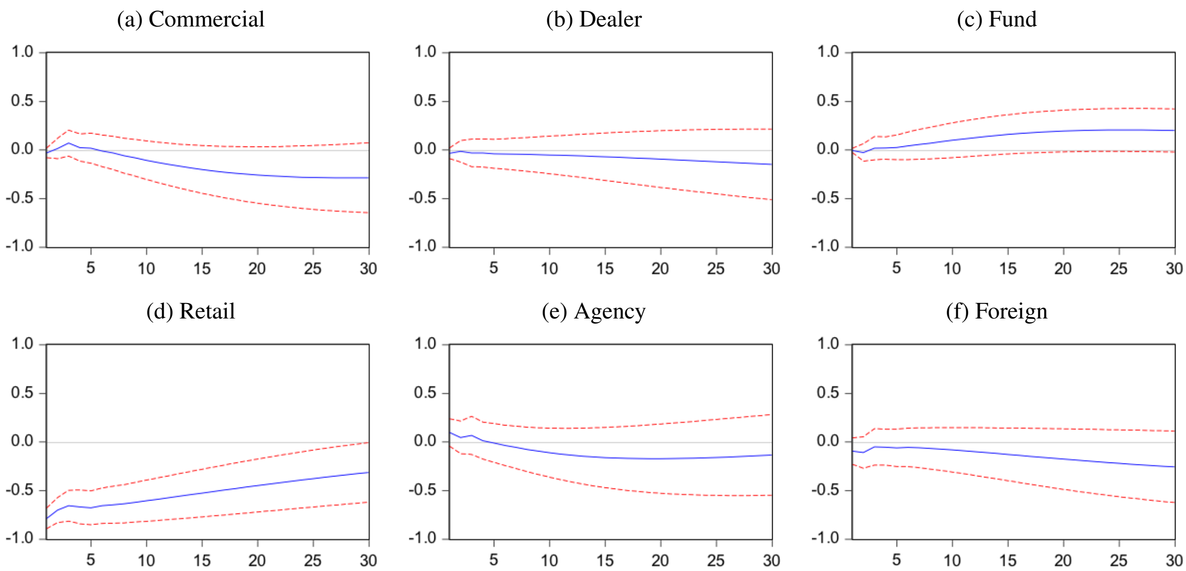

Figure B.5: Cumulative Impulse Response Functions of Return for Gasoline

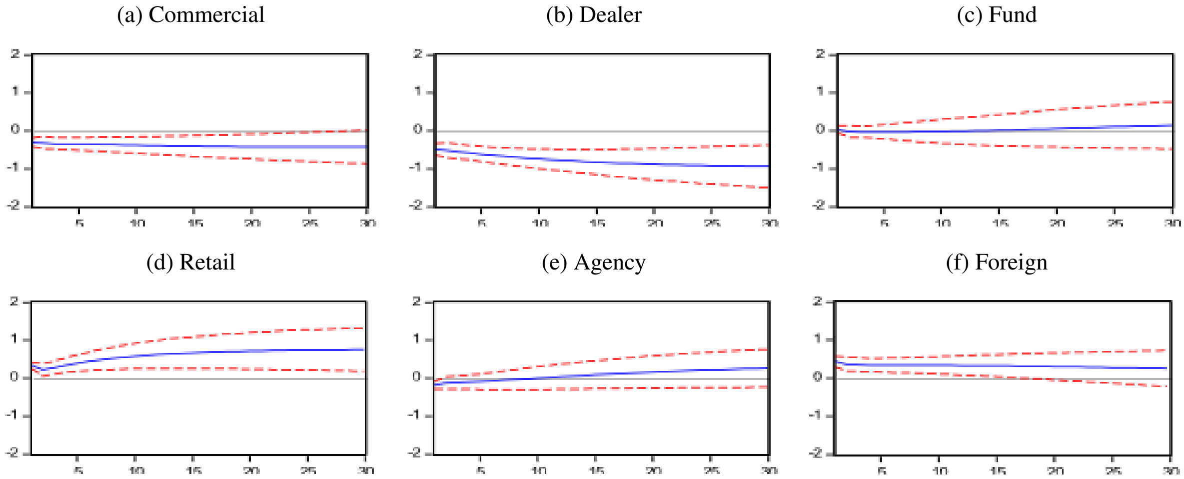

Figure B.6: Cumulative Impulse Response Functions of Return for Rubber