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Essays on Commodity and Currency Excess Returns

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Abstract

This Ph.D. thesis explores the dynamics of excess returns in two sophisticated asset classes: commodities and exchange rates. Specifically, the first chapter demonstrates that exchange rates are significantly exposed to downside tail-risk concerning several commodities. The second chapter focuses on the dynamics of commodity excess returns around the phenomenon of "financialization" of commodity markets, characterized by increased institutional investors and index capital flows into the commodity futures market. It finds that approximately 80% of commodity futures strategies that previously generated significant returns are no longer profitable after "financialization". Lastly, the third chapter reveals that financial intermediaries, along with changes in market participation among them that occurred with the "financialization", impact the dynamics of the subjective return expectations of professional forecasters in commodity markets.

Keywords: Commodity futures markets, Exchange rates, Financialization of commodities, Financial intermediation, Subjective return expectations.

JEL Classification: G12, G13, G14, G15, G20

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Introduction

This doctoral thesis consists of three essays in empirical asset pricing, focusing on two of the asset classes most predominantly held by financial intermediaries: commodities and exchange rates. Among these, commodities markets serve as the central theme of the dissertation. Specifically, the first chapter delves into the interconnections between the two asset classes by investigating commodity downside tail-risk in exchange rates. In the second chapter, the analysis centers on the dynamics of commodity excess returns around the phenomenon of "financialization" of commodity markets. The third chapter shifts its focus towards examining the impacts of financial intermediaries on subjective return expectations in commodity markets, particularly exploring how this relationship evolves in light of the "financialization". Below, I provide a more comprehensive overview of the three chapters and their respective objectives.

Chapter 1: "Commodity Tail-Risk and Exchange Rates"

The first chapter of this dissertation, written with Giovanni Rillo (LUISS University), studies the downside tail-risk relationship between currencies and commodities. In order to do so, we use the novel MCoVaR with Elastic-Net of Bonaccolto, Borri, and Consiglio (2021) to simultaneously account for the potential ties among a large set of commodities. We show that exchange rates are significantly exposed to downside tail-risk with respect to several commodities, including, but not limited to, oil and gold. Additionally, we find that different exchange rates are vulnerable to tail-risk in different commodities. Lastly, the results with respect to gold indicate that the Japanese yen and the Swiss franc can be considered safe-haven assets.

Chapter 2: "Commodity Returns: Lost in Financialization"

The second chapter, co-authored with Fahiz Baba-Yara (Indiana University), shifts the focus towards the financialization of commodity markets. The financialization, characterized by a dramatic increase in institutional investors and index capital flows into the commodity futures market around 2004, has significantly impacted the asset class. Our paper investigates the effect of this growth in investment capital on the average returns of popular commodity futures trading strategies over time. Our findings reveal that approximately 80% of commodity futures strategies that generated statistically significant average returns before financialization are no longer profitable. Our results suggest that this decline in strategy returns is primarily driven by an adverse change in the average returns of a few systematically priced factors in the cross-section of commodity futures. Furthermore, we find that commodity strategies with relatively higher exposure to the Dow Jones Commodity Index experience a significant reduction in average returns, providing a possible channel for this observed effect. Robustness tests indicate that the publication of commodity strategies in the academic literature accounts for only about 25% of the observed decrease in commodity futures strategy returns.

Chapter 3: "Subjective risk premia and intermediary asset pricing: evidence from commodity markets"

In the third and final chapter of this dissertation, I investigate the impact of financial intermediaries and shifts in market participation among different intermediary types on the dynamics of subjective risk premia. I measure subjective risk premia using return expectations of professional forecasters for commodities, a sophisticated asset class. Commodities provide an ideal setting as they allow to explore the unprecedented increase in institutional investor participation, beyond primary dealers, that occurred during the "financialization" of commodity markets. I show that the financial health of intermediaries, particularly primary dealers, plays a crucial role in driving subjective risk premia. However, with the change in the mix of market participants, the importance of primary dealers for subjective return expectations diminishes, while that of non-primary dealers increases. These findings reveal intermediaries as a novel source of variation in subjective risk premia, emphasize the significance of intermediary heterogeneity in shaping asset prices and highlight the time-varying nature of this relationship.

Chapter 1

Commodity Tail-Risk and Exchange Rates*

*This chapter was written in co-authorship with Giovanni Rillo. It was published in Finance Research Letters in June 2022. Bondatti: PhD student in Economics and Finance, Nova School of Business and Economics, R. Holanda 1, Carcavelos, Portugal; Corresponding author: massimiliano.bondatti@novasbe.pt. Rillo: PhD candidate in Economics, LUISS Guido Carli, Viale Romania 32, Rome, Italy; grillo@luiss.it. The authors thank Giovanni Bonaccolto, Nicola Borri, Federico Carlini, Joao B. Duarte and Tobias Stein (discussant) for helpful discussions and suggestions. Useful comments from two anonymous referees and from participants to the 1st International Conference "Frontiers in International Finance and Banking" at MGIMO University, 6th Econometric Research in Finance Workshop at the SGH Warsaw School of Economics, 14th Meeting of the Portuguese Economic Journal at the Catolica Porto Business School, 16th Warsaw International Economic Meeting at the University of Warsaw, XXII Quantitative Finance Workshop at the University of Verona, LUISS PhD Internal Seminar and Nova SBE PhD Internal Seminar are gratefully acknowledged. Massimiliano Bondatti acknowledges financial support from Fundação para a Ciência e a Tecnologia (grant BD/144901/2019). All errors remain our own.

1.1 Introduction

In many countries, especially among emerging economies, commodities are an important driver of output and inflows, and as such potentially correlated with exchange rates. Moreover, emerging countries experience higher macroeconomic volatility than rich countries, a fact that can be traced back to commodity price volatility (Jacks, O'rourke, and Williamson (2011)). In this paper, we study the relation between commodities and currencies from the perspective of commodity tail-risks in exchange rates. In particular, we consider the exchange rates of emerging economies as well as advanced countries, which we use as a control group, and analyse their exposures to tail-risks with respect to different commodities. In order to do so, we provide a novel application of the new MCoVaR with Elastic-Net of Bonaccolto, Borri, and Consiglio (2021).

We show that exchange rates are significantly exposed to downside tail-risk with respect to several commodities. Moreover, we find heterogeneous exposure across currencies, as different exchange rates are vulnerable to tail-risks in different commodities. More specifically, these (tail-risk) relationships are sometimes connected to relevance of that commodity with respect to the overall commodity exports for that country. However, interestingly, this appears to be not always the case. Additionally, and closely related, our results importantly highlight that conditional tail-risks are not only relevant with respect to oil or gold but also statistically and economically significant with respect to several different commodities. Lastly, when we analyze the estimates with respect to gold, we find that the Swiss franc and, especially, the Japanese yen exhibit safe-haven behaviours.

Overall, the paper contributes to two main streams of the literature. First, our work contributes to the literature analysing (conditional) tail-risk within and across asset classes. Several papers use the CoVaR of Adrian and Brunnermeier (2016), in different specifications, to study different assets and markets: sovereign bonds/CDSs (Borri (2019b), among others), cryptocurrencies (Borri (2019a) and Xu, Zhang, and Zhang (2021)), currencies and stocks (Reboredo, Rivera-Castro, and Ugolini (2016) and Liu and Yang (2017)), stocks and oil (Mensi et al. (2017)), sovereign CDS spreads and oil (Wang, Sun, and Li (2020)), Chinese and Asian stock markets (Jin (2018)), and US and Chinese stock sectors during COVID-19 (Hanif, Mensi, and Vo (2021)). However, to the best of our knowledge, applications to the link between commodities (broadly defined) and currencies are so far lacking. Moreover, recently, Bonaccolto, Borri, and Consiglio (2021), in estimating breakup and default risks in the Eurozone, extended the CoVaR model in two simultaneous directions. Specifically, they work at the intersection between multivariate, multi-quantile regression and high-dimensional networks. Their new estimator is the multiple-regression-CoVaR (MCoVaR) with Elastic-Net, on which our analysis builds.

Second, our paper contributes to the literature investigating the relation between commodities and exchange rates. Starting from the seminal paper of Chen and Rogoff (2003), several works have analysed this link either from the perspective of time-series predictability (Chen, Rogoff, and Rossi (2010) and Kohlscheen, Avalos, and Schrimpf (2017)) or of commodity-currencies cross-sectional risk premium (Ready, Roussanov, and Ward (2017) and Byrne, Ibrahim, and Sakemoto (2019)). Moreover, some existing works investigate the tail dependence between exchange rates and (only) oil or gold (Aloui, Aïssa, and Nguyen (2013), Chen, Choudhry, and Wu (2013), Reboredo (2013) and Bedoui et al. (2018)). Nevertheless, by providing a novel application of the MCoVaR with Elastic-Net, we take a different stance from these studies in several dimensions. First, our focus is on measuring and analysing non-causal *conditional tail-risk*. Second, we do not limit our attention exclusively to oil and gold: rather, we assess vulnerabilities of exchange rates to tail-risk in *several* different individual commodities ($j = 1, \ldots, J$). Third, the MCoVaR allows us to study the tail-risk relationship between the exchange rate-i and a commodity-j while, at the same time, accounting for the potential ties among the commodity-j and all the remaining $J - 1$ commodities. In doing so, we consider the possibility that one commodity is in a state of distress because of the effects of another (otherwise omitted) commodity; i.e. we address a potential omitted variable bias problem.

1.2 Data

We collect data for exchange rates from Reuters and for commodity prices from the S&P Goldman Sachs Commodity Index (henceforth, S&P GSCI), via Datastream. The data are daily and cover the period from 30/1/2004 to 29/06/2021. The choice of this time frame is consistent with the common practice of avoiding periods of high inflation and the introduction of the euro and allows us to have all the commodity prices from the beginning of the sample available.

We express spot rates as the number of U.S. dollars per unit of foreign currency. Thus, an increase in the spot rate represents a depreciation of the U.S. dollar. Our sample covers eight advanced economies: Australia, Canada, Japan, New Zealand, Norway, Sweden, Switzerland and United Kingdom; and eight emerging economies: Brazil, Chile, India, Mexico, Russia, Singapore, South Africa and South Korea.

Data for commodity prices – measured in U.S. dollar per unit – refer to commodities that are traded on active, liquid future markets. We collect 19 S&P GSCI individual indexes : Cocoa, Coffee, Cotton, Corn, Soybeans, Sugar, Wheat, Brent, Crude Oil, Natural Gas, Gold, Silver, Platinum, Copper, Lead, Nickel, Zinc, Lean Hogs and Feeder Cattle.

Commodities and exchange rate returns are computed as the change in the respective log spot prices (S_t):

$$ret_{t+1} = log(S_{t+1}) - log(S_t)$$

The separate Appendix (Table 1.2) presents descriptive statistics for the returns series.

1.3 Methodology

Bonaccolto, Borri, and Consiglio (2021) propose a multiple-regression CoVaR with shrinkage estimator (MCoVaR with Elastic-Net) that extends the popular CoVaR measure of Adrian and Brunnermeier (2016)[2]. This new model, by *jointly* estimating all the regressors, captures their po-

[2]CoVaR is a reduced-form risk-measure that allows to estimate the exposure of any asset to tail-risk of a second

tential simultaneous effects. Hence, the MCoVaR limits the potential omitted variable bias problem that arises when estimating *non-causal* conditional tail-risk through models, such as the CoVaR, that estimate the covariates *independently* from each other.

1.3.1 MCoVaR with Elastic-Net

We follow Bonaccolto, Borri, and Consiglio (2021) in estimating the MCoVaR with Elastic-Net with quantile regressions (introduced by Koenker and Bassett Jr (1978)):

$$Q_\theta(y_t^i) = \delta_\theta + \lambda_\theta X'_{t,J} + \psi_\theta y_{t-1}^i + \gamma_\theta M'_{t-1} \tag{1.1}$$

In Equation (1), y_t^i represents the returns on exchange rate-i, and $X_{t,J}$ is a $1 \times J$ vector ($X_{t,J} = [x_t^1\ x_t^2 \ldots x_t^J]$) containing all the commodities-returns[3]; and $\lambda_\theta = [\lambda_\theta^1\ \lambda_\theta^2 \ldots \lambda_\theta^J]$ are the corresponding parameters that quantify the impact of a shock to commodities on exchange rate-i. More specifically, we denote with x_t^j the residuals of an OLS regression of the returns on commodity-j (ret^j) on a basket of equally weighted currency returns excluding currency-i ($base_t^i$):

$$ret_t^j = \alpha^{j,i} + \psi^{j,i} base_t^i + x_t^j \tag{1.2}$$

with

$$base_t^i = \frac{1}{I-1} \sum_{n=1, n \neq i}^{I} y_t^n$$

Using the residuals from Equation (2) as our right-hand side variables in (1), we consider the orthogonalised commodity returns with respect to all the other currencies[4]. Moreover, Bonaccolto,

asset or of the market (as also Borri (2019a) and Borri (2019b) explain). In other words, CoVaR is a measure of risk conditional upon an adverse shock, where risk is the Value-at-Risk. While CoVaR is a leading measure of tail-risk, very popular also for its simplicity and flexibility, there exist also alternative measures of exposure to tail-risk, such as the SRISK of Brownlees and Engle (2017).

[3]While the CoVaR would include only one commodity x_t^j at the time (see the Appendix).

[4]Commodity prices are indeed expressed in U.S. dollars. Bilateral exchange rates are also expressed against the U.S. dollar. Hence, a potential concern is that a regression of exchange rates returns on the plain commodity returns would only capture the interaction between the currency component (i.e. the U.S. dollar component) of

Borri, and Consiglio (2021) include in the MCoVaR specification in (1) the lagged values of the dependent variable (y^i_{t-1}) which, instead, address the possible problem of serial correlation not captured in CoVaR. Lastly, M_{t-1} are the lagged returns on a set of common factors employed as conditioning variables. Specifically, we consider as controls the returns on the: S&P500, CBOE VIX volatility index and U.S. corporate bond index. Additionally, the quantile regression in equation (1) is simultaneously extended to account for the Elastic-Net estimation functional:

$$L(\delta_\theta, \beta_\theta) = \frac{1}{T-1} \sum_{t=2}^{T} \rho_\theta(y^i_t - \delta_\theta - \beta_\theta Z_t) + \nu \left[\alpha \|\beta_\theta\|_1 + \frac{1-\alpha}{2} \|\beta_\theta\|_2^2 \right] \tag{1.3}$$

where Z_t is the vector containing the regressors in (1), $\beta_\theta = [\lambda_\theta \ \psi_\theta \ \gamma_\theta]$ and

$$\|\beta_\theta\|_p = \left[\sum_{j=1}^{J} |\lambda_{\theta,j}|^p + |\psi_\theta|^p + \sum_{k=1}^{K} |\gamma_{\theta,j}|^p \right]^{\frac{1}{p}}$$

for $p \in \{1, 2\}$. The inclusion of the Elastic-Net of Zou and Hastie (2005) makes it possible to balance the bias and variance of the estimates and to perform variable selection thanks to the l_1 component. Since only the parameters attached to the regressors that have a high effect on the VaR of the dependent variable take non-zero values, this methodology improves the baseline CoVaR, which always returns non-zero ΔCoVaRs.

The MCoVaR is then defined as the Value at Risk (VaR) of the exchange rate-i conditional upon commodity-j being in a state of distress and it is obtained as the fitted values of the quantile regression in (1) *when* commodity-j is at its VaR ($\hat{q}_\tau(x^j_t)$). Hence, MCoVaR of the exchange rate-i conditional on, respectively, the state of distress and the median state of commodity-j is computed as follows:

both the dependent and independent variables. We avoid this issue by using instead as regressors the orthogonalised commodity returns with respect to a basket of equally weighted currency returns against the U.S. dollar (rather than the plain commodity returns). In this way, we capture more directly the actual linkage between exchange rates and (tail-risk in) commodities.

$$MCoVaR_{t,\theta,\tau}^{y_t^i|x_t^j=\hat{q}_\tau(x_t^j)} = \hat{\delta}_\theta + \hat{\lambda}_{j,\theta}\hat{q}_\tau(x_t^j) + \sum_{l=1,l\neq j}^{J} \hat{\lambda}_{l,\theta}x_t^l + \hat{\psi}_\theta y_{t-1}^i + \hat{\gamma}_\theta M_{t-1}^{'} \tag{1.4}$$

$$MCoVaR_{t,\theta,\frac{1}{2}}^{y_t^i|x_t^j=\hat{q}_{\frac{1}{2}}(x_t^j)} = \hat{\delta}_\theta + \hat{\lambda}_{j,\theta}\hat{q}_{\frac{1}{2}}(x_t^j) + \sum_{l=1,l\neq j}^{J} \hat{\lambda}_{l,\theta}x_t^l + \hat{\psi}_\theta y_{t-1}^i + \hat{\gamma}_\theta M_{t-1}^{'} \tag{1.5}$$

The vulnerability of currency-i to tail-risk in commodity-j is then measured with the ΔMCoVaR, i.e. as the difference between the MCoVaR of exchange rate-i conditional on a state of distress in commodity-j and conditional on its median state. Therefore, ΔMCoVaR is calculated by subtracting (5) from (4):

$$\Delta MCoVaR_\theta^{y^i|x^j} = \hat{\lambda}_{j,\theta}[\hat{q}_\tau(x_t^j) - \hat{q}_{\frac{1}{2}}(x_t^j)] \tag{1.6}$$

Overall, ΔMCoVaR quantifies the marginal impact of commodity-j (x_t^j) on the VaR of the exchange rate-i (y_t^i), i.e. when x_t^j moves from its normal state to its state of distress (its VaR). However, from (1), $\hat{\lambda}_{j,\theta}$ is now affected by the possible interactions with all the other commodities, differently from the standard CoVaR estimation.

1.4 Results

This section discusses the estimation results presented in Table 1.1. We select the quantile to be $\theta = \tau = 1\%$. The results can be summarized as follows.

First, we find that the exchange rates are vulnerable to tail-risks in the commodity markets. As we can see also from the heatmap in Figure 1.1, around 34% of all the estimated exposures are statistically significant and several of them are also economically meaningful[5]. This highlights

[5] Ranaldo and Söderlind (2010), for example, show that on 2% of the days the returns to the stock market (respectively, treasury notes) are associated with at least a 0.26% (respectively, 0.19%) return on the Swiss franc against the U.S. dollar, and denote these effects as economically significant. Our results indicate that states of distress in individual commodities are associated to fluctuations in foreign currencies (mainly depreciations against the U.S. dollar) often comparable, in terms of magnitudes, to their definition of economically significant forex fluctuations.

that currencies tend to experience relevant fluctuations on a day when commodities are hit by a shock equal to their VaR. Since the estimated ΔMCoVaR values tend to be negative, exchange rates tend to depreciate against the U.S. dollar when commodities are in a state of distress.

Second, these downside tail-risk relationships are heterogeneous across currencies. Different exchange rates are vulnerable to tail-risks with respect to different commodities. Several of the results point at a relation between currencies and commodities in terms of the relevance of that commodity with respect to the overall commodity exports for that country[6]. However, interestingly, we find that this commodity–currency link is not necessarily subject to the dependence of a country on the export of a commodity[7]. We summarize our results by describing in details the findings for one emerging economy commonly identified as a commodity-currency associated to oil, namely the Russian ruble. We find that the ruble has strong estimated vulnerabilities against brent and crude oil, with ΔMCoVaRs equal to -0.26% and -0.45%. This means that on a day when, for example, crude oil is in a state of distress, the ruble experiences an additional -0.45% drop with respect to the case where the commodity is in its median state. Nevertheless, the ruble exhibits an economically significant vulnerability against feeder cattle as well.

Third, while our paper studies the vulnerabilities to *conditional tail-risk* in a *broad* set of individual commodities (which are also *jointly* estimated), the previous literature on tail-dependence focused on the relationship between exchange rates and only oil or gold. With respect to these two commodities, the negative signs of our oil estimates are consistent with Aloui, Aïssa, and Nguyen (2013) and Bedoui et al. (2018). However, the significant tail-risk vulnerabilities to oil we find for the Canadian dollar and the British pound are different from the results in Aloui, Aïssa, and

[6]Table 1.5 in the Appendix reports, in the spirit of Kohlscheen, Avalos, and Schrimpf (2017), the share of a commodity export revenues in total commodity export revenues for each country.

[7]One potential economic reason underlying this finding is that global factors drive some of these relations between exchange rates and tail-risk in commodities. However, an exhaustive explanation in this direction would require a theoretical macro-finance model which is beyond the scope of this paper and, as such, we leave this interesting discussion open for future research. Partly related, in a recent work Ayres, Hevia, and Nicolini (2020) develop a general equilibrium model of trade in primary commodities with productivity shocks and shocks to the supply of commodities, and show a comovement between real exchange rates of three developed economies (against the U.S. dollar) and four commodity prices due to common factors.

Nguyen (2013), who find little tail dependence for these currencies. Thus, together with the significant estimates we get also for the Norwegian krone and Russian ruble, our results seem partly at odds with their claim that higher oil reserves and production positions of a country reduce its exchange rates' tail dependence on oil price fluctuations[8]. Additionally, the vulnerabilities to tail-risk in gold present several positive values, except for the Swiss franc and the Japanese yen, which are negative. Overall, we believe our results for gold can be interpreted as follows. Gold returns tend to be high in periods of distress and low in good times. At the same time, the U.S. dollar has flight-to-safety properties (Lilley et al. (2020)); meanwhile, the Swiss franc and the Japanese yen are the two leading safe-haven currencies (Ranaldo and Söderlind (2010)). Hence, when gold is in a state of distress (good times) the U.S. dollar depreciates against all exchange rates but the Swiss franc and the Japanese yen. Gold and, in this order, the Japanese yen, Swiss franc and U.S. dollar behave as safe assets for international investors.

Finally, in Figure 1.2 we compare the results between the MCoVaR and the basic CoVaR methodology (reported in Table 1.3 in the Appendix). Overall, estimating the *conditional* tail-risk relationships with the CoVaR would have still allowed us to draw one of our main conclusions, namely that exchange rates are vulnerable to tail-risk in several commodities. However, as we see in the graph, downside tail-risks measured by the ΔMCoVaR tend to be often different from the ones measured by the ΔCoVaR[9]. Hence, if we overlooked a potential omitted variable bias problem, we would have erroneously attributed to exchange rates several vulnerabilities which are actually not significant. Additionally, in a few circumstances, considering the ties among the commodities on the right-hand side of the quantile regression makes some vulnerabilities emerge or reinforce. Eventually, the magnitudes arising from the MCoVaR estimation are in general smaller.

[8]This interpretation appears potentially in contrast with the results we find also across other types of commodities and with the (partial) connection of these relationships with the export channel.

[9]Similarly, as we show in Figure 1.3a in the Appendix, for exchange rates *conditional* tail-risk values (ΔMCoVaRs) are significantly different from uncondtional risk values (VaR).

1.5 Conclusions

In this paper, we study the relation between exchange rates and commodity prices through the lens of a conditional tail-risk model, namely the novel MCoVaR with Elastic-Net. We show that different exchange rates are vulnerable to a state of distress of different individual commodities, with these tail-risk threats coming from several different (types of) individual commodities, even beyond oil and gold.

The findings of this paper can be of interest to global investors, financial institutions and firms, as they can serve as a useful tool for risk management and portfolio decisions. To this end, our results are relevant to correctly measure the risk and diversification of financial portfolios, as well as to implement strategies to hedge forex exposures from commodity shocks. Additionally, our findings have interesting implications for policymakers in terms of designing policies and provisions to curb the volatility of portfolio allocations of financial investors, such as controls on international trades and production of commodities, or fiscal and monetary policies, aimed at stabilizing commodity prices and, consequently, fluctuations in exchange rates. Eventually, these conditional tail-risk relationships we uncover have implications for the choice of commodity producers over the currency invoicing in international trade of commodities (i.e. local currencies vs U.S. dollar as invoicing currency), which is currently a relevant policy debate[10].

[10]Financial Times; "Russia sanctions threaten to erode dominance of US dollar, says IMF". 31/3/2022.

1.6 Tables and Figures

Table 1.1: ΔMCoVaR with Elastic-Net

Country	Coc$^{\|}$	Cof$^{\|}$	Cot$^{\|}$	Cor$^{\|}$	Soy$^{\|}$	Sug$^{\|}$	Wht$^{\|}$	Bre$^{\prime}$	CrO$^{\prime}$	NaG$^{\prime}$	Cop§	Led§	Nic§	Znc§	FeC$^{\#}$	LeH$^{\#}$	Gld†	Slv†	Pla†
Emerging Countries																			
Brazil	-0.08	-0.13***	-0.16***	-0.13***	-0.17***	-0.22***	-0.03	-0.13***	-0.00	-	-0.15***	-	-	-	-	-	0.07**	-	-0.10***
Chile	-	-	0.02	-0.00	-0.02	-0.01	-0.19***	-	-	-0.14**	-0.32***	-	0.08**	-	-0.16***	-	0.29***	-0.20***	-
India	-	-	-0.01	-	-	-	-	-	-	-	-0.30***	-	-	-	-	-	0.00	-	-
Mexico	-0.04	-	-0.04	-0.25**	-	-	-	-0.18***	-	-	-0.24**	-	-	0.17*	-0.25***	-0.00	0.76***	-	-0.72***
Russia	-	-	-	-	-	-	-	-0.26*	-0.45***	-	-	-	-	-	-0.35***	-	-	-	-
Singapore	-	-	-	-0.04**	-	-	-0.06***	-0.03**	-0.01	-0.05**	-	-	-	0.04***	-0.05**	-0.02*	-	-	-
South Africa	-0.05	-0.05	-	-	-	-	-0.07	-0.07*	-0.06*	-	-0.17***	-	-0.05	-	-0.01	-	0.03	-	-
South Korea	-0.03	-	0.01	-	-	-	-	-0.29***	-	-	-0.21**	-0.02	-0.00	-	-0.25***	-	0.43***	-	-0.21***
Developed Countries																			
Australia	-0.08	0.05	-	-0.25**	-	-	-	-	-	-0.19***	-0.72***	-	0.09***	0.24***	-0.04	-	-	-0.23***	0.07***
Canada	-0.10**	0.07	-	-0.46***	0.13**	-	-	-	-0.20***	-0.14***	-0.25***	-0.06*	-	0.43***	-0.04	0.19***	-	-0.07*	-
Japan	-	-0.08*	0.10**	0.00	0.21***	0.25***	-0.12**	-	-	0.14**	0.03	0.18***	0.11*	-	-	-	-0.45***	-	-0.11**
New Zealand	-	-	-	-0.06***	-	-	-	-	-	-0.30***	-0.05*	-	-	-	-0.13**	-	-	-0.12*	-
Norway	-0.15**	0.06*	-	-	-0.30***	-	-	-0.24***	-	-0.35***	-	-	0.01	0.05	-0.21**	-0.04	-	-0.07	-
Sweden	-	0.05**	-	-0.13***	-0.09*	-	-0.01	-0.00	-	-0.12***	-	-	0.03	0.09***	-0.14***	-	0.09**	-	-
Switzerland	-0.11***	-	-	0.00	-	0.10***	-	0.11***	0.08***	-0.10***	0.03	0.02	0.01	0.07***	0.07**	-0.01	-0.10***	-0.10***	0.02
United Kingdom	-0.17***	-	-	-0.11***	-0.00	-	-	-0.14***	-0.05**	-0.06**	-	-	0.02	0.21***	-0.07***	-	0.10***	0.00	-

Notes: This table reports the estimated values for the ΔMCoVaR with Elastic-Net in (6), with confidence level τ=θ=1%. In all the estimates, the left-hand side variables of the regressions in (1) (i.e. the exchange rate-i) are on the rows of the table, and the right-hand conditioning variable (i.e. commodity-j) on the columns of the table. The other independent variables in each regressions in (1) are the remaining j = $1, \ldots, J-1$ commodities, the $t-1$ values of the dependent variable, and the set of common factors which include: the returns on the S&P500, on the CBOE VIX volatility index and on the US Corporate Bond Total Return Index. We divide exchange rates of developed and emerging countries in two different panels. Standard errors are computed by wild-bootstrap (Wang, Van Keilegom, and Maidman (2018)) as in Bonaccolto, Borri, and Consiglio (2021). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. Statistical significance refers to the coefficients $\hat{\lambda}_{j,\theta}$ from equation (6). We report with - values that the ΔMCoVaR with Elastic-Net method shrinks below 10^{-3}. Data are daily, for the period 01/2004-06/2021, and obtained from Datastream. The commodities are: Cocoa (Coc), Coffee (Cof), Cotton (Cot), Corn (Cor), Soybeans (Soy), Sugar (Sug), Wheat (Wht), Brent (Bre), Crude Oil (CrO), Natural Gas (NaG), Copper (Cop), Lead (Led), Nickel (Nic), Zinc (Znc), Feeder Cattle (FeC), Lean Hogs (LeH), Gold (Gld), Silver (Slv), Platinum (Pla). $^{\|}$ refers to commodities belonging to the agricultural-category, $^{\prime}$ to the energy-category, † to the precious metals-category, § to the industrial metals-category and $^{\#}$ to livestock-category.

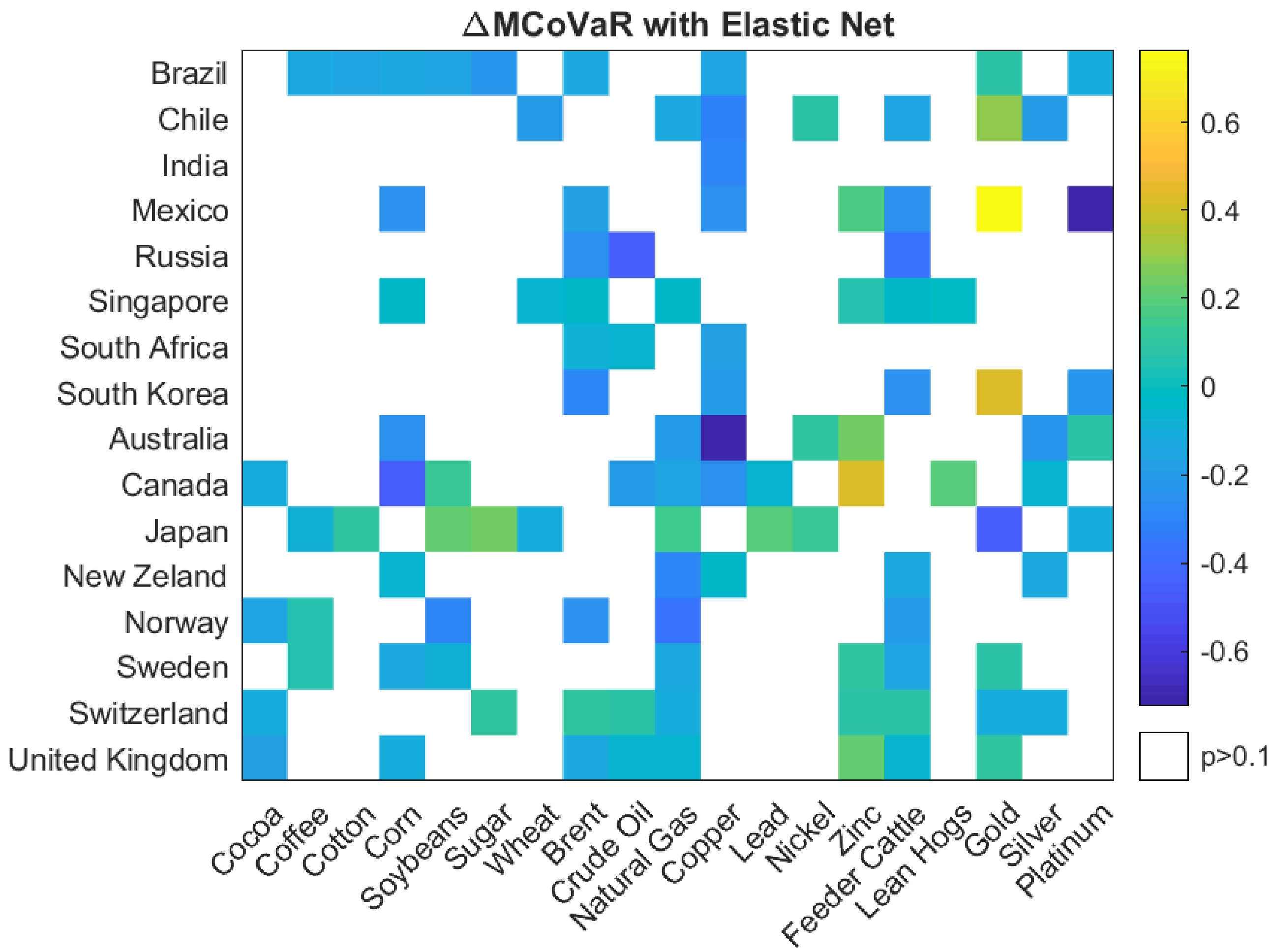
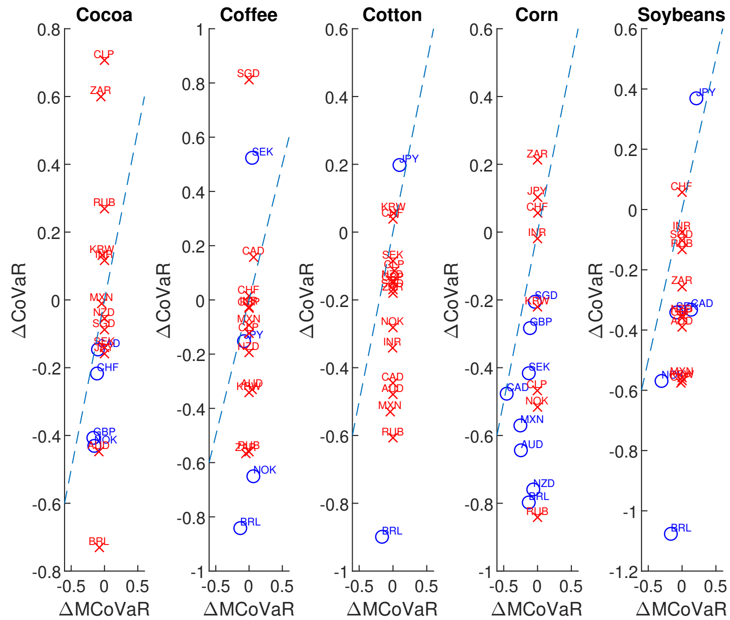
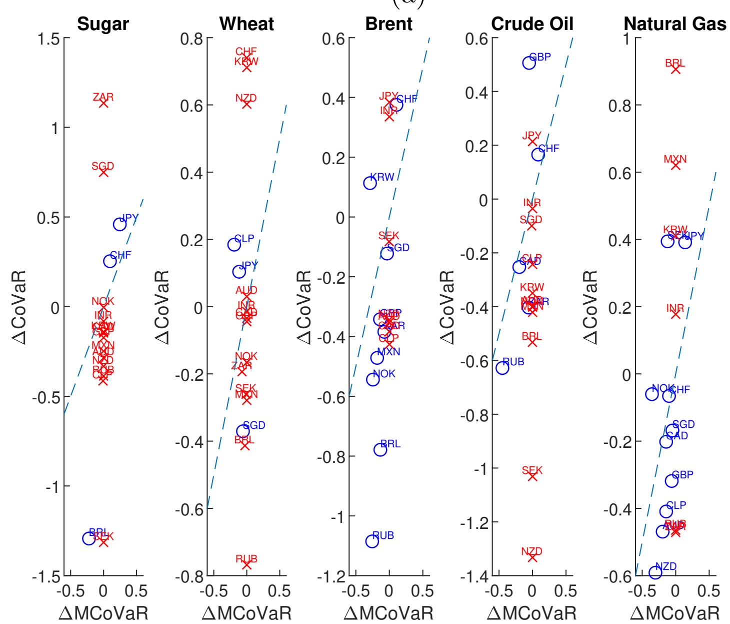


Figure 1.1: Heatmap: ∆MCoVaR with Elastic-Net

This figure shows the heatmap for the results of the estimated values for the ∆MCoVaR with Elastic-Net reported in Table 1.1. In white, we display values that are either not selected by the ∆MCoVaR with Elastic-Net or statistically not significant at the 10% level. In parallel to Table 1.1, we report in the top half of the figure the exchange rates belonging to emerging economies, and in the bottom half the exchange rates belonging to developed economies.



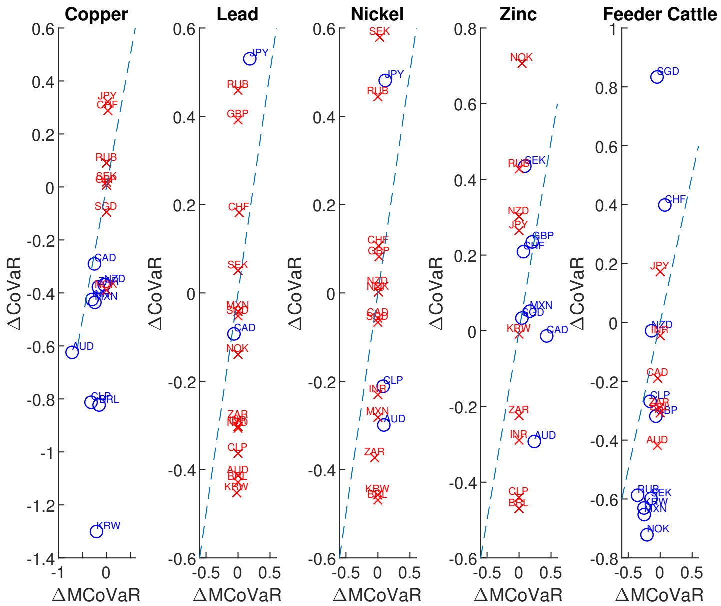
(a)



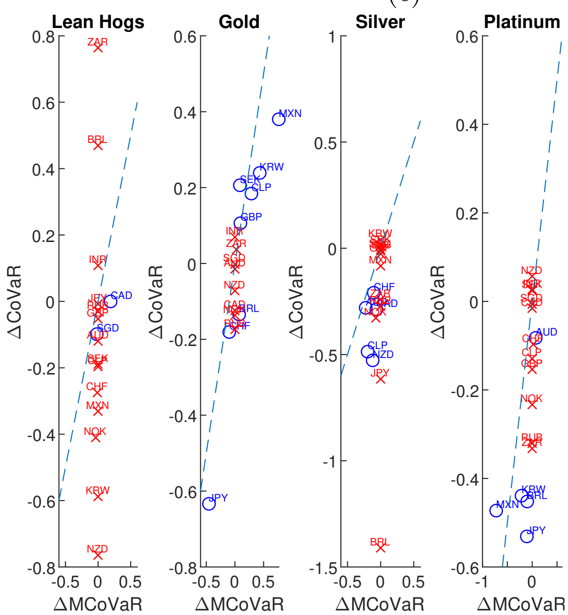
(b)

Figure 1.2: ΔCoVaR vs ΔMCoVaR

The scatter plot shows the weak correlation between exchange rates' tail-risk to extreme commodity returns when the effects of the commodities are considered independently from each other, measured by ΔCoVaR (y-axis), and exchange rates tail-risk to extreme commodity returns when the effects of the commodities are considered simultaneously, measured by the ΔMCoVaR (x-axis). The ΔCoVaR and ΔMCoVaR are conditional 99% measures and are reported in daily percent returns. ΔCoVaR refers to equation (10) in the Appendix, while ΔMCoVaR to equation (6). The exchange rates (our y variables) and commodities (our x variables) names are listed in Section 2. Red crosses represent values of the ΔMCoVaR that are not statistically different from zero and/or are not selected by the MCoVaR with Elastic-Net method.



(c)



(d)

Figure 1.2: ΔCoVaR vs ΔMCoVaR

The scatter plot shows the weak correlation between exchange rates' tail-risks to extreme commodity returns when the effects of the commodities are considered independently from each other, measured by ΔCoVaR (y-axis), and exchange rates tail-risk to extreme commodity returns when the effects of the commodities are considered simultaneously, measured by the ΔMCoVaR (x-axis). The ΔCoVaR and ΔMCoVaR are conditional 99% measures and are reported in daily percent returns. ΔCoVaR refers to equation (10), while ΔMCoVaR to equation (6). The exchange rates (our y variables) and commodities (our x variables) names are listed in Section 2. Red crosses represent values of the ΔMCoVaR that are not statistically different from zero and/or are not selected by the MCoVaR with Elastic-Net method.

1.7 Appendix

Descriptive Statistics

Table 1.2 shows the descriptive statistics for the returns series. Average daily returns are close to zero, mainly left skewed and exhibit excess kurtosis. These characteristics point at non-normality of the returns' distributions, consistent with the analysis of the previous literature. For many return series, there is a greater probability of extremely negative realizations than the one of a normal distribution. Moreover, commodity returns are overall more volatile than exchange rate returns, both in terms of standard deviations and the spreads between maximum and minimum values observed over the sample, although often with slightly lower (in absolute terms) values for skeweness and kurtosis. Lastly, unconditional Value-at-Risk at the $\tau = 0.01$ quantile (i.e. 0.99 confidence level) for exchange rate returns ranges from -0.91% to, at most, -2.96%; for commodities the range is from -3.01% to -7.52%.

Table 1.2: Descriptive Statistics

Country	$Mean\%$	$Std\%$	Skw	Krt	$Max\%$	$Min\%$	VaR 1%	Acf
Exchange Rates								
Australia	-0.00	0.82	-0.78	16.91	6.94	-8.83	-2.20	-0.04
Brazil	-0.01	1.00	-0.33	10.04	7.45	-8.12	-2.77	-0.03
Chile	-0.01	0.69	-0.39	8.09	4.92	-5.46	-1.86	0.04
Canada	0.00	0.60	0.08	8.06	5.05	-4.34	-1.57	-0.01
India	-0.01	0.42	-0.44	9.80	3.06	-3.97	-1.27	0.02
Japan	-0.00	0.63	0.28	7.61	4.61	-3.71	-1.67	-0.02
Mexico	-0.01	0.75	-0.71	12.85	5.33	-7.55	-2.17	0.02
New Zealand	0.00	0.85	-0.40	9.00	5.88	-6.65	-2.35	-0.01
Norway	-0.00	0.80	-0.20	8.35	6.46	-6.05	-2.28	-0.00
Russia	-0.02	0.88	-0.52	50.67	15.52	-14.27	-2.53	0.03
Singapore	0.01	0.34	-0.00	7.82	2.34	-2.14	-0.91	-0.03
South Africa	-0.02	1.06	-0.37	6.78	6.39	-9.81	-2.96	0.02
South Korea	0.00	0.69	0.79	56.23	13.26	-10.35	-1.88	-0.01
Sweden	-0.00	0.75	0.08	7.06	5.55	-5.09	-1.97	-0.02
Switzerland	0.01	0.66	0.89	35.77	11.42	-9.00	-1.52	0.02
United Kingdom	-0.01	0.63	-0.74	15.14	4.47	-8.31	-1.59	0.03
Commodities								
Cocoa	0.01	1.77	-0.17	5.23	8.99	-9.78	-4.74	
Coffee	0.02	1.97	0.11	4.72	12.06	-11.25	-4.97	
Cotton	0.00	1.66	-0.16	4.48	6.94	-7.58	-4.65	
Corn	0.02	1.76	0.01	5.16	9.17	-8.12	-4.83	
Soybeans	0.01	1.51	-0.23	5.43	6.78	-7.34	-4.58	
Sugar	0.03	1.99	-0.45	8.24	8.56	-22.46	-5.34	
Wheat	0.01	1.83	0.11	4.44	8.10	-8.99	-4.77	
Brent	0.02	2.23	-0.54	15.05	19.08	-26.83	-6.35	
Crude Oil	0.02	2.73	-1.61	72.44	43.79	-56.86	-6.82	
Natural Gas	-0.01	2.90	0.18	5.47	17.13	-19.18	-7.52	
Copper	0.03	1.73	-0.13	7.36	11.90	-10.38	-4.76	
Lead	0.03	2.07	-0.17	6.33	12.84	-13.03	-5.79	
Nickel	0.00	2.28	-0.13	6.51	13.16	-18.22	-6.26	
Zinc	0.02	1.94	-0.15	5.44	9.93	-11.13	-5.15	
Feeder Cattle	0.01	1.07	-0.07	5.27	7.48	-5.87	-3.01	
Lean Hogs	0.01	1.84	-0.02	5.08	9.81	-12.53	-4.49	
Gold	0.03	1.15	-0.37	8.44	8.59	-9.81	-3.29	
Silver	0.03	2.12	-0.91	9.80	12.47	-19.49	-7.11	
Platinum	0.01	1.54	-0.52	8.20	11.19	-12.22	-4.54	

Notes: This table reports mean, standard deviation, skeweness, kurtosis, maximum value, minimum value, value-at-risk (VaR) and (lag-1) auto-correlation for the log daily returns on exchange rates (top panel) and on commodities (bottom panel). Mean, standard deviation, maximum, minimum and VaR are in percentages. For the value-at-risk, the confidence level is $\tau = 1\%$. Data are daily, for the period 01/2004 to 06/2021, and retrieved from Datastream.

CoVaR

The Conditional-Value-at-Risk (CoVaR) is a measure of risk conditional upon an adverse shock, where risk is the Value-at-Risk[11]. The Value-at-Risk, in turn, quantifies risk in terms of returns at a certain probability. We use (M)CoVaR to estimate the conditional tail-risk of commodity-j on exchange rate-i.

More specifically, we follow Adrian and Brunnermeier (2016) in estimating CoVaR with quantile regressions (introduced by Koenker and Bassett Jr (1978))

$$Q_\theta(y_t^i) = \delta_\theta + \lambda_\theta x_t^j + \gamma_\theta M'_{t-1} \tag{1.7}$$

In Equation (7), y_t^i represents the returns on exchange rate-i, and (as explained in Section 3.1) x_t^j denotes the residuals of an OLS regression of the returns on commodity-j (ret^j) on a basket of equally weighted currency returns excluding currency-i ($base_t^i$):

$$ret_t^j = \alpha^{j,i} + \psi^{j,i} base_t^i + x_t^j \tag{1.8}$$

with

$$base_t^i = \frac{1}{I-1} \sum_{n=1, n \neq i}^{I} y_t^n$$

Lastly, M_{t-1} are the lagged returns on a set of common factors employed as conditioning variables. Specifically, we consider as controls the returns on the: S&P500, CBOE VIX volatility index and U.S. corporate bond index.

$CoVaR^{y_t^i | x_t^j}$ is then defined as the Value at Risk (VaR) of currency-i conditional upon commodity-j being in a state of distress, and it is obtained as the fitted values of the quantile

[11] As Adrian and Brunnermeier (2016), indeed, write, systemic risk measures capture the potential for the spreading of distress across institutions (or, alternatively, assets) by gauging this increase in tail comovement. ΔCoVaR is a reduced-form measure of contributions to systemic risk that captures tail dependency.

regression in (1) *when* commodity-j is at its VaR ($\hat{q}_\tau(x_t^j)$):

$$CoVaR_{t,\theta,\tau}^{y_t^i|x_t^j=\hat{q}_\tau(x_t^j)} = \hat{\delta}_\theta + \hat{\lambda}_\theta \hat{q}_\tau(x_t^j) + \hat{\gamma}_\theta M'_{t-1} \tag{1.9}$$

The vulnerability of currency-i to tail-risk in commodity-j is then measured with the ΔCoVaR, i.e. as the difference between the CoVaR of exchange rate-i conditional on a state of distress in commodity-j and conditional on its median state:

$$\Delta CoVaR_{\theta,\tau}^{y^i|x^j} = \hat{\lambda}_\theta[\hat{q}_\tau(x_t^j) - \hat{q}_{\frac{1}{2}}(x_t^j)] \tag{1.10}$$

So, ΔCoVaR quantifies the marginal impact of commodity-j (x_t^j) on the VaR of the exchange rate-i (y_t^i), i.e. when x_t^j moves from its normal state to its state of distress (its VaR).

ΔCoVaR Results

In Table 1.3 we report the estimated ΔCoVaR values, described at the end of Section 4 and plotted in Figure 1.2 (against the ΔMCoVaR values from Table 1.1).

Table 1.3: ΔCoVaR

Country	Coc$^{\|}$	Cof$^{\|}$	Cot$^{\|}$	Cor$^{\|}$	Soy$^{\|}$	Sug$^{\|}$	Wht$^{\|}$	Bre$^{\prime}$	CrO$^{\prime}$	NaG$^{\prime}$	Cop§	Led§	Nic§	Znc§	FeC$^{\#}$	LeH$^{\#}$	Gld†	Slv†	Pla†
Emerging Countries																			
Brazil	-0.73***	-0.84**	-0.90***	-0.80	-1.08***	-1.29***	-0.41	-0.78**	-0.53	0.91**	-0.82**	-0.43**	-0.47*	-0.47	-0.31	0.47	-0.13	-1.41***	-0.45**
Chile	0.71***	-0.12	-0.11	-0.47***	-0.58***	-0.41***	0.18	-0.43***	-0.24	-0.41***	-0.81***	-0.36*	-0.21	-0.44	-0.27***	-0.20	0.18	-0.49***	-0.13
India	0.12	-0.03	-0.34***	-0.02	-0.08	-0.08	-0.01	0.34***	-0.04	0.18	-0.42***	-0.30***	-0.23*	-0.29***	-0.05	0.11	0.07	-0.01	0.03
Mexico	-0.01	-0.09	-0.53***	-0.57***	-0.56***	-0.25	-0.28	-0.47***	-0.42**	0.62**	-0.44***	-0.04	-0.28*	0.05	-0.65***	-0.33**	0.38**	-0.08	-0.47***
Russia	0.27	-0.56**	-0.61*	-0.84***	-0.13	-0.39	-0.77**	-1.09***	-0.63***	-0.46*	0.09	0.46	0.44**	0.43	-0.59**	-0.03	-0.17	-0.27	-0.32
Singapore	-0.09*	0.81***	-0.17***	-0.21***	-0.10**	0.75***	-0.37***	-0.12***	-0.10**	-0.17***	-0.10**	-0.05	-0.07	0.03**	0.83***	-0.10*	-0.00	-0.01	-0.01
South Africa	0.60**	-0.57***	-0.18*	0.21**	-0.26	1.14***	-0.19	-0.38**	-0.40***	-0.47***	-0.38***	-0.29*	-0.37*	-0.22***	-0.29**	0.76***	0.04	-0.24	-0.33***
South Korea	0.13	-0.34***	0.06	-0.22	-0.57***	-0.14	0.71***	0.11	-0.35***	0.41*	-1.30***	-0.45***	-0.46***	-0.01	-0.63***	-0.59***	0.24	0.04	-0.44***
Developed Countries																			
Australia	-0.45**	-0.33**	-0.48***	-0.64**	-0.39***	-0.29	0.03	-0.35***	-0.40***	-0.47***	-0.62**	-0.41***	-0.30*	-0.29**	-0.42**	-0.12	-0.01	-0.28	-0.08
Canada	-0.15	0.16***	-0.45***	-0.48***	-0.33***	-0.15	-0.03	-0.38**	-0.25***	-0.20	-0.29***	-0.09	-0.06	-0.01	-0.19	-0.00	-0.12	-0.29	-0.02
Japan	-0.16	-0.15	0.20**	0.10	0.37***	0.46***	0.10**	0.38	0.21	0.39***	0.32***	0.53**	0.48***	0.26***	0.17	-0.01	-0.63***	-0.62***	-0.53*
New Zealand	-0.05	-0.19	-0.14	-0.76***	-0.35**	-0.33	0.60***	-0.34***	-1.33***	-0.59***	-0.37***	-0.31***	0.01	0.30*	-0.03	-0.76***	-0.07	-0.53***	0.06
Norway	-0.43***	-0.65***	-0.28**	-0.52***	-0.57***	-0.00	-0.17	-0.54	-0.40***	-0.06	-0.39	-0.14***	0.00	0.71*	-0.72***	-0.41***	-0.14	-0.33***	-0.23**
Sweden	-0.14**	0.52***	-0.08	-0.42***	-0.34*	-1.31***	-0.26	-0.08	-1.03***	0.39***	0.02	0.05	0.58***	0.43***	-0.60***	-0.19	0.21***	0.01	0.02
Switzerland	-0.22**	0.01	0.04	0.06	0.06	0.25*	0.74**	0.38***	0.17**	-0.07	0.29**	0.18***	0.11	0.21	0.40*	-0.27***	-0.18***	-0.21***	-0.10*
United Kingdom	-0.41***	-0.03	-0.15*	-0.28***	-0.36***	-0.17**	-0.04	-0.34***	0.51**	-0.32***	0.01	0.39***	0.08**	0.23***	-0.32***	-0.05	0.11	-0.03	-0.15***

Notes: This table reports the estimated values for the ΔCoVaR in (10), with confidence level τ=θ=1%. In all the estimates, the left-hand side variables of the regressions in (7) (i.e. the exchange rate-i) are on the rows of the table, and the right-hand conditioning variable (i.e. commodity-j) on the columns of the table. The other independent variables in each regressions in (7) are the set of common factors which include: the returns on the S&P500, on the CBOE VIX volatility index and on the US Corporate Bond Total Return Index. We divide exchange rates of developed and emerging countries in two different panels. Standard errors are computed by wild-bootstrap (Wang, Van Keilegom, and Maidman (2018)) as in Bonaccolto, Borri, and Consiglio (2021). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. Statistical significance refers to the coefficients $\hat{\lambda}_\theta$ from equation (10). Data are daily, for the period 01/2004-06/2021, and obtained from Datastream. The commodities are: Cocoa (Coc), Coffee (Cof), Cotton (Cot), Corn (Cor), Soybeans (Soy), Sugar (Sug), Wheat (Wht), Brent (Bre), Crude Oil (CrO), Natural Gas (NaG), Copper (Cop), Lead (Led), Nickel (Nic), Zinc (Znc), Feeder Cattle (FeC), Lean Hogs (LeH), Gold (Gld), Silver (Slv), Platinum (Pla). $^{\|}$ refers to commodities belonging to the agricultural-category, $^{\prime}$ to the energy-category, † to the precious metals-category, § to the industrial metals-category and $^{\#}$ to livestock-category.

Upside Tail-Risk

Our main goal was to assess whether exchange rates are vulnerable to downside tail-risk in the commodity markets. Moreover, we showed in the descriptive statistics that the data are mainly left skewed and exhibit excess kurtosis. However, for completeness, we analyse upside tail-risk spillovers as well, i.e. we assess exchange rates' vulnerabilities to commodity returns being in the right tail of their distribution (now, considering the upper 1% quantile). The results for the MCoVaR with Elastic-Net in Table 1.4 might be of interest (especially) to investors with open short positions.

As expected, the estimated vulnerabilities are now often economically smaller than in the case of downside tail-risk. Hence, exchange rates tend to be more correlated to negative shocks in commodities fluctuations than to positive shocks. Nevertheless, we still find some economically and statistically significant results.

Moreover, the results show some degree of heterogeneity across currencies. In some circumstances, they are also symmetric to the findings for the downside MCoVaR. Both developed and emerging currencies, such as the Australian dollar and Brazilian real among others, present relevant vulnerabilities to upside commodity tail-risks. Meanwhile, exchange rates such as the Swedish krone and the Singapore dollar show again few and weak estimates of ΔMCoVaR. As an example, we see that in a day when sugar (coffee) is experiencing high returns, the Brazilian real experiences an additional +0.49% (+0.32%) gain compared to when the commodity is in its median state; i.e. the BRL now appreciates against the U.S. dollar.

Interestingly, we also see that the Japanese yen and the Swiss franc present strong vulnerabilities to gold, but now with a positive sign. This means that in a situation when gold returns spike up, i.e. in a bad state of the world (a period of financial market turmoil), the U.S. dollar depreciates against these two currencies. Hence, the Japanese yen and the Swiss franc are the exchange rates that show potential safe-haven behaviours in both downside and upside tail-risk spillovers.

Table 1.4: ΔMCoVaR with Elastic-Net (Upside Tail-Risk)

Country	Coc$^{\|}$	Cof$^{\|}$	Cot$^{\|}$	Cor$^{\|}$	Soy$^{\|}$	Sug$^{\|}$	Wht$^{\|}$	Bre$^{\prime}$	CrO$^{\prime}$	NaG$^{\prime}$	Cop§	Led§	Nic§	Znc§	FeC$^{\#}$	LeH$^{\#}$	Gld†	Slv†	Pla†
Emerging Countries																			
Brazil	-0.22***	0.32***	-	0.01	0.23**	0.49***	-0.13*	0.20***	0.11***	-0.05	0.32***	0.16*	0.01	-	-	-0.28***	-0.36***	0.11**	0.07
Chile	-0.10**	-	-	-	-	0.16***	-0.15**	-	0.00	-	-	-	0.05	-	-	-0.01	-0.12**	-0.06	-
India	0.03	-0.00	-	-	-0.06*	0.27***	-	-0.16***	-	0.13***	-	-	-	0.13***	-	-	0.16**	-0.26***	-
Mexico	-0.42***	-	-	0.07	-0.05	0.16**	-	0.06	0.06	0.01	0.00	0.19**	0.21**	-0.42***	0.22***	-0.15**	-0.10*	0.03	-0.22***
Russia	-	-0.06**	-	-	-0.05*	0.01	-0.09***	0.15***	0.09***	-	-	-	-	0.02	0.06**	-	-0.04	-0.03	-0.02
Singapore	-	-0.00	-	-0.02	-	0.12***	-0.11**	-0.00	-0.07**	-	-	-	-0.06*	-	0.04**	-	-	-	-
South Africa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Korea	-0.03	0.01	-0.03	-0.02	0.12**	0.13*	-	-	-0.07*	0.11*	-0.09**	0.24***	-0.03	-0.08*	0.22***	-0.05	-0.08	-0.20***	0.07**
Developed Countries																			
Australia	-0.09*	-	-	0.21***	-	0.13**	-0.04	-0.00	-0.13***	-	0.24***	0.03	-	-	0.22***	-0.05*	-0.08**	-	-
Canada	-	-	-	-	-	-	-	0.07***	-	-	0.08***	0.03	-	-	-	-	-	-	-
Japan	0.00	-0.02	-0.08*	-0.30***	-	-0.07	0.12**	-0.24***	-	-	-0.46***	0.13**	-0.07	0.02	-0.55***	0.15***	0.65***	-	-0.08*
New Zealand	0.13**	-	-	0.15***	-0.24***	0.13***	-	-0.05	-0.11***	-	0.11**	0.05	0.06	0.02	0.12**	-0.00	-	0.11**	-0.03
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.01	-	-	0.20***	-	-
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Switzerland	0.07*	-0.07**	0.14***	-	-0.02	0.02	0.03	-0.12**	-0.17***	0.01	0.08**	-	-0.14***	-	-0.14***	0.03	0.44***	-	-0.15***
United Kingdom	0.42***	-0.10*	-	0.08**	-0.06	0.20***	-0.15**	-	-0.23***	0.09*	0.24***	-	-0.11**	-0.11*	0.04	-	-	0.07	-

Notes: This table reports the estimated values for the ΔMCoVaR with Elastic-Net in (6), but now with confidence level τ=θ=99%. In all the estimates, the left-hand side variables of the regressions in (1) (i.e. the exchange rate-i) are on the rows of the table, and the right-hand conditioning variable (i.e. commodity-j) on the columns of the table. The other independent variables in each regressions in (1) are the remaining j $= 1, \dots, J-1$ commodities, the $t-1$ values of the dependent variable, and the set of common factors which include: the returns on the S&P500, on the CBOE VIX volatility index and on the US Corporate Bond Total Return Index. We divide exchange rates of developed and emerging countries in two different panels. Standard errors are computed by wild-bootstrap (Wang, Van Keilegom, and Maidman (2018)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. We report with - values that the ΔMCoVaR with Elastic-Net method shrinks below 10^{-3}. Statistical significance refers to the coefficients $\hat{\lambda}_{j,\theta}$ from equation (6). Data are daily, for the period 01/2004-06/2021, and obtained from Datastream. The commodities are: Cocoa (Coc), Coffee (Cof), Cotton (Cot), Corn (Cor), Soybeans (Soy), Sugar (Sug), Wheat (Wht), Brent (Bre), Crude Oil (CrO), Natural Gas (NaG), Copper (Cop), Lead (Led), Nickel (Nic), Zinc (Znc), Feeder Cattle (FeC), Lean Hogs (LeH), Gold (Gld), Silver (Slv), Platinum (Pla). $^{\|}$ refers to commodities belonging to the agricultural-category, $^{\prime}$ to the energy-category, † to the precious metals-category, § to the industrial metals-category and $^{\#}$ to livestock-category.

Shares of Commodity in Total Exports

In Table 1.5, we report the most important commodities for each country according to their share in total export revenues, in a similar vein to Table 9 in Kohlscheen, Avalos, and Schrimpf (2017). Due to space constraints and for exposition clarity, we include for each country only the commodity groups that account for more than 0.3% of the exports. The data are retrieved for the period 2007–2017 from UN Comtrade. We use classification based on the three-digit level. However, since some commodities are not available or impossible to disentangle at this level of granularity, we recur to the four-digit SIC for certain commodities (e.g. silver and platinum).

Table 1.5: Shares of Commodity Groups in Exports

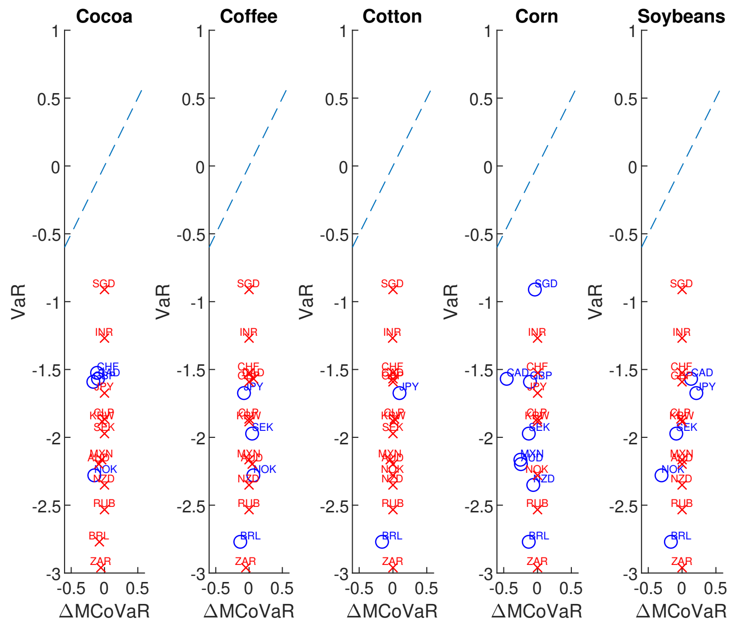
	Description of Group	**Export Over Total Exports (%)**
Australia	Gold	6,24
	Natural Gas	4,63
	Brent/Crude Oil	3,60
	Wheat	2,08
	Copper	1,38
	Cotton	0,61
	Zinc	0,47
	Lead	0,41
	Feeder Cattle	0,37
Brazil	Soybeans	8,26
	Brent/Crude Oil	6,95
	Sugar	4,92
	Coffee	2,80
	Corn	1,69
	Gold	1,02
	Cotton	0,56
	Copper	0,39
Canada	Brent/Crude Oil	13,76
	Natural Gas	3,38
	Gold	3,04
	Wheat	1,35
	Copper	0,63
	Nickel	0,62
	Soybeans	0,36
Chile	Copper	31,65
	Gold	1,42
	Brent/Crude Oil	1,11
	Silver	0,48
India	Copper	0,99
	Cotton	0,96
	Sugar	0,48
Japan	Copper	0,96
	Gold	0,91
Mexico	Brent/Crude Oil	9,90
	Gold	1,40
	Silver	0,73
	Copper	0,39
New Zealand	Brent/Crude Oil	3,38
	Gold	1,11
	Sugar	0,56
	Silver	0,30
Norway	Brent/Crude Oil	32,71
	Natural Gas	23,08
	Nickel	1,22
Republic of Korea	Copper	0,77
	Gold	0,37
Russia	Brent/Crude Oil	30,43
	Natural Gas	10,89
	Copper	1,10
	Nickel	1,00
	Wheat	0,95
	Gold	0,67
Singapore	Gold	2,42
South Africa	Platinum	10,04
	Gold	4,83
	Corn	0,57
	Brent/Crude Oil	0,51
	Sugar	0,40
	Nickel	0,39
	Copper	0,38
Sweden	Copper	0,90
	Gold	0,44
Switzerland	Gold	15,02
	Platinum	1,27
	Coffee	0,68
United Kingdom	Brent/Crude Oil	5,23
	Gold	3,83
	Platinum	0,87
	Natural Gas	0,66
	Silver	0,37

Notes: This table reports the share in total export revenues for commodity groups in each country. For space constraints, for each country we report only the commodities whose share is above a 0.30% threshold. The share is compiled based on UN Comtrade data between 2007 and 2017, at three-digit level (four-digit, when a three-digit code is not available for a certain commodity).

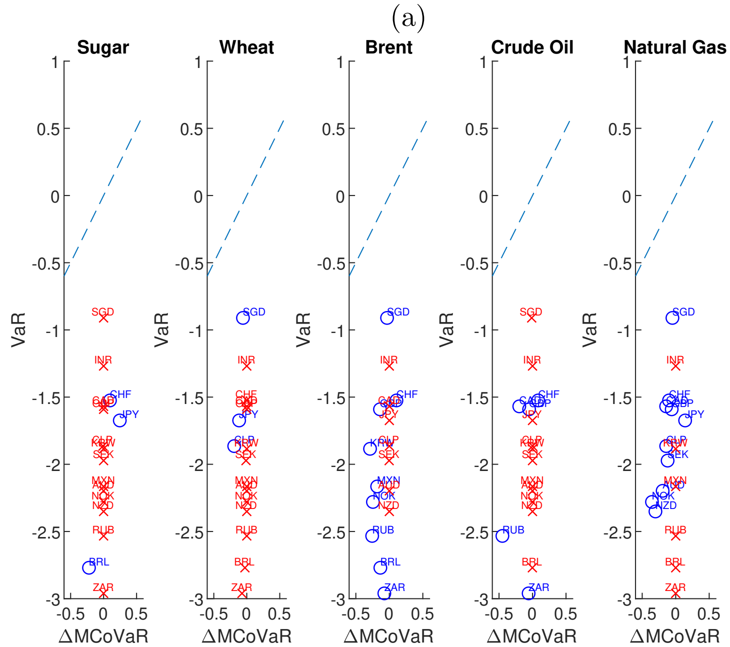
VaR vs ΔMCoVaR

In Figure 1.3, which is inspired by Figure IV.1 of Adrian and Brunnermeier (2016), we show that exchange rate-i's tail-risk to commodity-j (ΔMCoVaR$^{y^i|x^j}$) is different from the exchange rate's own risk measure (VaR-i). As we see, since the dots do not lie on the 45° degree line, downside ΔMCoVaR values are significantly different from the VaR values among all the exchange rates for each commodity.

Therefore, it is important to regulate the forex market and to hedge FX exposure based not only on exchange rate' risk in isolation but also taking into account the *conditional* tail-risks coming from the commodities market.



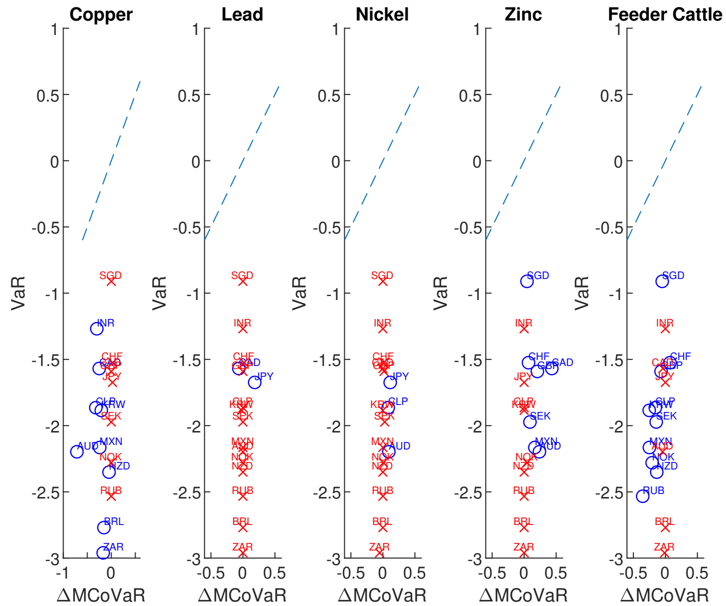
(a)



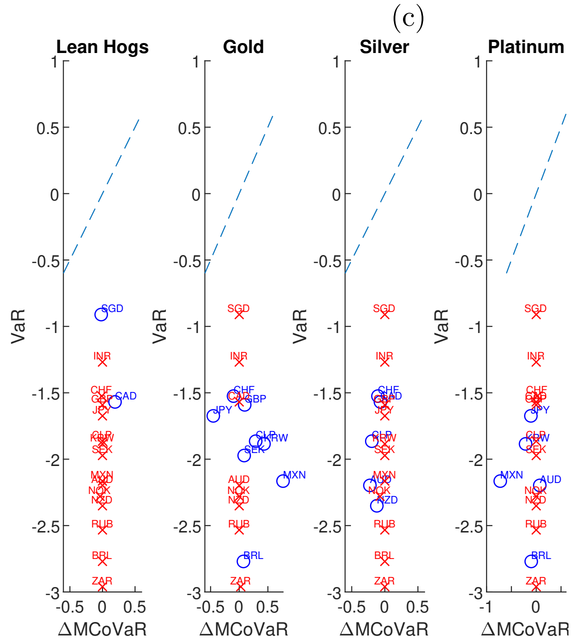
(b)

Figure 1.3: VaR vs ΔMCoVaR

The scatter plot, inspired to Figure IV.1 of Adrian and Brunnermeier (2016), shows the weak correlation between exchange rates' risk in isolation, measured by the VaR (y-axis), and exchange rates' tail-risks to extreme commodity returns, measured by the ΔMCoVaR (x-axis). The VaR and ΔMCoVaR are unconditional 99% measures and are reported in daily percent returns. ΔMCoVaR is the difference between the exchange rates-i's VaR conditional on commodity-j's distress and the exchange rates-i's VaR conditional on commodity-j's median state. The exchange rates (our y variables) and commodities (our x variables) names are listed Section 2. Red crosses represent values of the ΔMCoVaR that are not statistically different from zero and/or are not selected by the MCoVaR with Elastic-Net method.



(c)



(d)

Figure 1.3: VaR vs ΔMCoVaR

The scatter plot, inspired to Figure IV.1 of Adrian and Brunnermeier (2016), shows the weak correlation between exchange rates' risk in isolation, measured by the VaR (y-axis), and exchange rates' tail-risks to extreme commodity returns, measured by the ΔMCoVaR (x-axis). The VaR and ΔMCoVaR are unconditional 99% measures and are reported in daily percent returns. ΔMCoVaR is the difference between the exchange rates-i's VaR conditional on commodity-j's distress and the exchange rates-i's VaR conditional on commodity-j's median state. The exchange rates (our y variables) and commodities (our x variables) names are listed Section 2. Red crosses represent values of the ΔMCoVaR that are not statistically different from zero and/or are not selected by the MCoVaR with Elastic-Net method.

Chapter 2

Commodity Returns: Lost in Financialization*

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2.1 Introduction

In this paper, we show that an unprecedented increase in investment capital into the commodity futures market has significantly reduced the average returns of most commodity trading strategies. Since 2004, the financialization of commodity futures markets has emerged as a significant phenomenon characterized by a substantial increase in investment capital. Around this period, both retail and institutional investors sought to diversify their portfolios beyond traditional assets, such as stocks and bonds, by investing in commodity futures (Basak and Pavlova (2016)). This trend led to a significant influx of investment capital directed toward indexing, which involves tracking commodity indexes like the S&P Goldman Sachs Commodity Index (SPGCI) and the Dow Jones Commodity Index (DJCI). This growth in index investment capital has been remarkable, increasing from approximately $15 billion in 2003 to around $200 billion in 2008 (CFTC (2008), Henderson, Pearson, and Wang (2015a)).

Policymakers and academic researchers have extensively studied the financialization of commodity futures markets. Early research predominantly focused on the influence of index capital inflows on commodity prices and volatility. However, more recent literature has expanded its scope to investigate the impact of changing price informativeness on firms with significant economic exposure to commodities due to their production processes. For example, Brogaard, Ringgenberg, and Sovich (2019) find that financialization has diminished the ability of these firms to extract valuable signals from market prices for decision-making purposes.

In this paper, we investigate the impact of financialization on the average returns of twenty distinct commodity futures strategies. Our findings reveal a considerable decline in the informativeness of commodity prices following the financialization of commodity markets. Before 2004, thirteen of the twenty strategies we examined yielded at least marginally significant returns. However, after financialization, only three strategies continue to produce significant returns.

We put forth and examine two possible explanations for this stylized fact. The first hypothesis contends that many of these strategies were previously able to capitalize on idiosyncratic mispricings across various commodity futures. However, the financialization-driven surge in index capital has led to the elimination of these mispricings. The second hypothesis posits that a few systematic commodity factors, such as risk or behavioral factors, underlie the returns of these strategies (see Kozak, Nagel, and Santosh (2018)). In this scenario, an increase in index investors could decrease the average returns of these factors, thereby lowering the average returns to commodity futures strategies.[2]

To this end, we propose a six-factor asset pricing model and show that this model explains most of the priced variations across the twenty commodity futures strategies. Our findings suggest that the average return of the individual factors has significantly decreased following the influx of investor capital. Consequently, we attribute the decline in average returns to commodity futures strategies as stemming from the reduction in returns to a handful of factors that drive returns in this market.

The existing literature on commodity futures strategies posits that demand and supply imbalances fundamentally drive the positive average returns of these strategies. These imbalances serve as signals for speculative capital, indicating whether additional capital is needed on the demand or supply side to facilitate market clearing. However, the growing presence of commodity indexers, who are mainly net long and unresponsive to demand imbalances, raises questions about the potential impact on the profitability of commodity strategies (see Keynes (1930b), Singleton (2014), Henderson, Pearson, and Wang (2015a)). Our findings speak to this question. Specifically, we find that strategies with higher exposure to index capital experience significant reductions in profitability.

To address the concern that the decrease in strategy returns may be due to the widespread adoption of these strategies rather than the financialization of the market, we conduct tests similar to those in McLean and Pontiff (2016). Our findings suggest that approximately 75% of the average decline in returns can be attributed to the financialization of commodity markets, while

[2]See Chabakauri and Rytchkov (2021) for a general equilibrium model of this effect.

the remaining 25% results from the increased popularity of these strategies.

The results in this paper are important for several reasons. First, we uncover a novel channel through which the financialization of commodity futures has impacted the asset class. Specifically, we show that the influx of index capital has depressed returns to most commodity strategies. Second, we introduce a simple agnostic linear asset pricing model that summarises the cross-section of commodity futures strategies. This model shows that returns to commodity futures strategies exclusively come from exposure to a handful of systematic factors in this cross-section. Lastly, we show that the decline in strategy returns follows from significant exposure to commodities in popular long-only commodity indexes such as the DJCI.

This study contributes to three main strands of the literature. Firstly, it adds to the body of research on cross-sectional and time-series predictability in commodity futures markets. A number of recent studies have identified several variables that successfully predict fluctuations in commodity returns: carry and basis (Szymanowska et al. (2014), Bakshi, Gao, and Rossi (2019), Koijen et al. (2018)), momentum (Miffre and Rallis (2007), Szymanowska et al. (2014) and Bakshi, Gao, and Rossi (2019)), basis-momentum (Boons and Prado (2019)), reversal (Bianchi, Drew, and Fan (2015)), value (Asness, Moskowitz, and Pedersen (2013) and Baba Yara, Boons, and Tamoni (2021)), coefficient of variation (Dhume (2010)), volatility and inventory (Gorton, Hayashi, and Rouwenhorst (2013)), open interest (Hong and Yogo (2012)), hedging pressure (De Roon, Nijman, and Veld (2000), Basu and Miffre (2013) and Kang, Rouwenhorst, and Tang (2020)), liquidity (Marshall, Nguyen, and Visaltanachoti (2012) and Marshall, Nguyen, and Visaltanachoti (2013)), inflation and the dollar (Erb and Harvey (2006) and Gorton and Rouwenhorst (2006)), skewness (Fernandez-Perez et al. (2018)) and level (Bakshi, Gao, and Rossi (2019)).[3] Our research expands upon this literature by comparing the average returns of these strategies before and after financialization. Additionally, we decompose the returns into what can be explained by systematic variation in the cross-section of commodity markets and what fraction is idiosyncratic to a par-

[3]Section 2.2.2 and the Appendix (2.8) provide an in-depth explanation of the economic rationale behind each variable and their construction.

ticular commodity. Using a six-factor linear asset pricing model, we find that the returns to all twenty strategies we study are attributable to systematic variation in this cross-section.

Our second contribution is to the strand of the literature that studies how the financialization of commodity markets has affected the cross-section of commodity futures. CFTC (2008) finds that open interest and investment inflow into commodity indexes increased substantially around 2004. Cheng and Xiong (2014) discuss how this phenomenon can affect commodity futures and, subsequently, the real economy. Boons, De Roon, and Szymanowska (2014), Büyükşahin and Robe (2014), Christoffersen and Pan (2018), and Melone et al. (2021), among others, find that the correlation between stock and commodity futures markets dramatically changed around this point. Brogaard, Ringgenberg, and Sovich (2019) show that index investing, which has increased during the post-financialization period, reduces the price informativeness of index commodities and, consequently, decreases the sensitivity of index commodity firms to commodity futures prices. Closely related, Hamilton and Wu (2014) find a change in oil futures risk premia since 2005 associated with the increasing importance of index-fund investing relative to commercial hedging in affecting crude oil futures risk premia. While, theoretically, Basak and Pavlova (2016) and Goldstein and Yang (2021) argue that commodity futures prices, volatilities, price informativeness, and correlations across commodities and with other assets (e.g., stocks) increase with the financialization. Lastly, Baker (2021) calibrates a macro-finance model for storable commodities. The author finds a decrease in the risk premium of storable commodities in response to the financialization. We contribute to this literature by showing that returns to several prominent commodity futures strategies have materially declined after the financialization of commodity markets. Our results suggest that the fall in strategy returns has happened because the average returns to the pricing factors in this asset class have significantly fallen following financialization.

Finally, our paper contributes to the asset pricing literature that studies return predictors after publication. The seminal work in this literature (McLean and Pontiff (2016)) studies the post-publication stock return predictability of 97 variables and finds that returns are on average, 58% lower. Similar results also hold in the forex market (Bartram et al. (2023)). Hou, Xue, and Zhang (2020) find that most equity anomalies fail to hold up to currently acceptable standards for empirical finance. However, a Bayesian modeling framework Jensen, Kelly, and Pedersen (2021) show that most anomalies replicate. We focus on commodity markets as opposed to equity and forex markets. Additionally, we do the exercise in the spirit of McLean and Pontiff (2016), and Bartram et al. (2023), but through the lens of the financialization of a market. We find that the commodity futures market has also experienced a significant decay in returns in recent years. However, we find that only about 25% of this decay can be attributed to the popularization of the strategies through publication compared to financialization.

The remainder of the paper is organized as follows. Section 3.2 presents the data and commodity trading strategies. Section 2.3 examines the impact of commodity markets financialization on average returns to commodity strategies. Section 2.4 explains the economic rationale behind the decay and explores an index-investing channel that can help rationalize our findings. Section 2.5 provides robustness checks. Finally, Section 2.6 concludes.

2.2 Data and commodity futures strategies construction

Our sample begins in March 1986 and ends in August 2021. We collect end-of-day data on liquid commodity futures contracts from the Commodity Research Bureau (CRB) for the period spanning March 1986 to December 2014. Extending our analysis to August 2021, we incorporate data from Datastream (now Refinitiv) and Factset. March 1986 is selected as the starting date to ensure access to futures returns data for a sufficient number of commodity strategies across different sorting variables, while also maintaining balance between the pre- and post-financialization periods.[4] Overall, our analysis covers 32 commodity futures contracts across four major sectors: agriculture, livestock, energy, and metals.

[4] At each point in time, there are at least 25 commodities to be allocated into (at most 5) portfolios for each sorting variable. Moreover, the starting date aligns with Szymanowska et al. (2014).

2.2.1 Commodity futures returns

We conduct most of our analysis at the monthly frequency and compute holding period returns using end-of-month prices. Specifically, we adopt the approach outlined in Bakshi, Gao, and Rossi (2019) for constructing commodity excess returns between period t and $t+1$. At the end of each month-t, we enter a position in the commodity-specific futures contract with the second shortest maturity, guaranteeing that its first notice day occurs *after* the end of month $t+1$. By rolling into the shortest maturity contract before the first notice day for each commodity, we ensure that we are never forced to take physical delivery of a commodity.[5] This convention is broadly consistent with Hong and Yogo (2012), Gorton, Hayashi, and Rouwenhorst (2013), among others.

The returns of the long and short commodity futures positions are computed as:

$$
\begin{aligned}
r_{t+1}^{long} &= r_t^f + \frac{1}{F_t^{(1)}}(F_{t+1}^{(1)} - F_t^{(1)}) \\
r_{t+1}^{short} &= r_t^f - \frac{1}{F_t^{(1)}}(F_{t+1}^{(1)} - F_t^{(1)})
\end{aligned}
$$

where r_t^f represents the interest earned on a fully collateralized futures position, and $F_t^{(1)}$ denotes the price of the next maturity futures contract at the end of month t.[6] Excess returns between period t and $t+1$ are then calculated as:

$$
e_{t+1}^{long} \equiv r_{t+1}^{long} - r_t^f \tag{2.1}
$$

$$
e_{t+1}^{short} \equiv r_{t+1}^{short} - r_t^f
$$

[5]For further details on the futures return construction, we direct interested readers to Bakshi, Gao, and Rossi (2019), and to their Table I in the internet Appendix for details on the first notice day convention.

[6]Consequently, $F_{t+1}^{(1)}$ indicates the price of the next maturity futures contract observed at the end of month $t+1$ (i.e., when the position is closed), and $F_t^{(0)}$ denotes the price of the front-month futures contract observed at the end of month t (i.e. when the position is open).

Table 2.5 in the Internet Appendix presents the descriptive statistics for the individual commodity futures excess returns. For approximately 25 out of the 32 commodities under study, the average return is positive. This indicates that a long-only rolling strategy, as outlined earlier, typically yields a positive return over our sample period. Consistent with findings in the literature (see Bakshi, Gao, and Rossi (2019)), individual commodity strategies tend to exhibit high volatility, resulting in Sharpe ratios of these long-only rolling strategies typically below 0.25. Additionally, commodity futures often display positive skewness, as observed in Table 2.5, providing suggestive evidence for why it is the preferred asset class of Trend-Following traders. Lastly, all commodities are available for at least two-thirds of the sample period.

2.2.2 Investment strategies definitions

Several variables documented in the literature have been shown to forecast variations in the cross-section of commodity futures returns. In this section, we elaborate on how we construct these characteristics and subsequently form portfolios by sorting the 32 commodities we analyze based on these characteristics. We adhere to the portfolio sorting scheme proposed in the articles that introduced each predictor.

First, we construct the commodity carry strategy following the approach outlined in Bakshi, Gao, and Rossi (2019) and Koijen et al. (2018), and the basis strategy as described in Szymanowska et al. (2014) and Boons and Prado (2019). Both predictors have been demonstrated to forecast returns in both the cross-section and the time series of commodity futures.

Second, we construct different versions of long- and short-term momentum following the methodologies outlined in Miffre and Rallis (2007), Szymanowska et al. (2014), Boons and Prado (2019), and Bakshi, Gao, and Rossi (2019). Specifically, we create two 12-month momentum strategies (*Mom12* and *MoB12*), one 6-month (*Mom06*), 3-month (*Mom03*), and 1-month momentum (*Mom01*). While *MoB12* adheres to the description provided in Boons and Prado (2019), *Mom12* follows the methodology outlined in Szymanowska et al. (2014). Additionally, we include a reversal factor (*Rever*) as described in Bianchi, Drew, and Fan (2015).

Third, we construct the basis-momentum factor (*BaMom*) introduced in Boons and Prado (2019), which integrates both momentum and basis fundamental signals. This factor is associated with the slope and curvature of the commodity futures curve, and it reflects imbalances in the supply and demand of future contracts that arise when the market-clearing ability of speculators and intermediaries is impaired.

Fourth, we incorporate a set of volatility-based measures. The coefficient of variations computed using spot prices (*CVDhu*) is sourced from Dhume (2010), while the one using returns (*CVSzy*) is obtained from Szymanowska et al. (2014)). Additionally, we include a volatility factor (*Volat*) constructed as outlined in Gorton, Hayashi, and Rouwenhorst (2013), which the authors demonstrate to be linked to inventory levels.

Fifth, we construct the inventory predictor (*Inven*), inspired by Gorton, Hayashi, and Rouwenhorst (2013).[7] The theory of storage (Kaldor (1939), Working (1949), Brennan (1958), and Deaton and Laroque (1996)) relates to the timing option inherent in holding a storable commodity. The act of deferring the consumption of a commodity to the future (i.e., when its supply might be scarce) drives its prices above the value of consuming it immediately and generates the convenience yield of holding the commodity. Therefore, according to this theory, the carry of a storable commodity directly translates into the cost of storing it. Holders of inventories earn a convenience yield that is a decreasing and convex function of inventory levels. Thus, the commodity futures risk premium diminishes with increasing inventories. For a comprehensive review of this topic, we also refer to Cheng and Xiong (2014).

The sixth set of variables is related to the hedging pressure theory of Keynes (1930b) and Hicks (1939). Hedgers in the futures market tend to be in a net short position and want to eliminate their risk. To incentivize other market participants to assume this risk, hedgers must offer their counterparties a premium to induce them to take the long position. Hedging pressure (*HedPr*) has

[7]We express our gratitude to Martijn Boons for generously sharing the inventory data with us. The inventory factor covers the period only up to 2011.

been demonstrated to affect commodity excess returns by Bessembinder (1992), De Roon, Nijman, and Veld (2000) and Basu and Miffre (2013), among others. We include a related predictor, open interest (*OpeIn*), which Hong and Yogo (2012) have shown to similarly predict commodity prices beyond imbalances among hedgers.

The seventh set of variables aims to exploit the cross-sectional heterogeneity in the conditional correlation between commodity returns and prominent macro-variables (see Erb and Harvey (2006), Gorton and Rouwenhorst (2006) and Szymanowska et al. (2014)). We include an inflation-β (*InflB*) variable, which is based on the conditional correlation between commodity future returns and inflation, and a dollar-β (*DollB*) variable, aiming to exploit a similar correlation between commodity futures returns and exchange rate risk (commodity future prices are typically denominated in a currency, often the U.S. dollar).

Eighth, we sort portfolios based on a liquidity variable (*Liqui*), specifically the Amivest measure proposed by Amihud, Mendelson, and Lauterbach (1997), which is inspired by Marshall, Nguyen, and Visaltanachoti (2012) and Marshall, Nguyen, and Visaltanachoti (2013). Expected commodity excess returns can reflect the contract's liquidity, as liquidity may vary across futures or maturities.

Ninth, we construct a standard value factor (*Value*), following the methodology outlined in Asness, Moskowitz, and Pedersen (2013) and Baba Yara, Boons, and Tamoni (2021). The value factor is computed using long-term past returns, building on the well-established literature that identifies correlations between past returns and book-to-market ratios (see De Bondt and Thaler (1985), Daniel, Hirshleifer, and Subrahmanyam (1998), and Gerakos and Linnainmaa (2018)).

Tenth, we construct a skewness factor (*Skewn*) following the approach outlined by Fernandez-Perez et al. (2018). As demonstrated by the authors, in line with predictions from theories on investors' skewness preferences or selective hedging, this factor yields significant returns and is capable of explaining the cross-section of commodity futures returns.

Finally, we include a level factor as proposed in Bakshi, Gao, and Rossi (2019). This factor is the equally-weighted commodity strategy (*Averg*) that goes long in all available commodities at month t.

2.3 Financialization and the cross-section of commodity futures returns

In this section, we offer a brief overview of the financialization of commodity futures markets and underscore its impact on various commodity futures strategies.

2.3.1 Background on financialization

Traditionally, the commodity futures market has been primarily dominated by two main participants: commercial hedgers and noncommercial traders. Commercial hedgers typically consist of primary producers of commodities, such as farmers, and primary users of commodities, such as oil refineries. These participants engage in hedging activities to mitigate the risk associated with spot-price fluctuations affecting their business operations. On the other hand, noncommercial traders include managed money traders such as hedge funds and Commodity Trading Advisors (CTAs). These entities take positions on either the long or short side of the market, aiming to help balance out the demand and supply dynamics between primary commodity producers and users.

Around the turn of the millennium, there was a remarkable surge in fund flows into commodity futures as an asset class. Index investment inflows into this space surged from approximately $20 billion in 2003 to more than $200 billion in 2008 and to about $300 billion in 2010 (CFTC (2008), Irwin and Sanders (2011)). Concurrently, the total U.S. exchange-traded futures and futures options trading volume increased from around 630 million contracts per year in 1998 to about 3.2 billion contracts per year in 2007, with growth observed across all commodities. As documented by Boons, De Roon, and Szymanowska (2014) and Brogaard, Ringgenberg, and Sovich (2019), among others, open interest across numerous commodities remained relatively stable between 2000 and

2003. However, it experienced a significant upsurge after 2004.[8] As highlighted in reports by Domanski and Heath (2007), CFTC (2008), and Irwin and Sanders (2011), the number of contracts outstanding in exchange-traded commodity derivatives (and their dollar values) surged by more than threefold. Concurrently, there was a notable shift in the composition of market participants, with the entry of institutional and index investors (Domanski and Heath (2007), Boons, De Roon, and Szymanowska (2014), Irwin and Sanders (2011), Brogaard, Ringgenberg, and Sovich (2019)). By 2008, approximately 24% of the total net notional value of funds invested in commodity indexes was held by "Index Funds," while approximately 42% was held by "Institutional Investors" (CFTC (2008)). Overall, this shift in market structure, dated to the beginning of 2004 in the literature (see Boons, De Roon, and Szymanowska (2014), Basak and Pavlova (2016), Brogaard, Ringgenberg, and Sovich (2019), among others), is referred to as the financialization of commodity futures markets.

Academics, regulators, and practitioners continue to investigate the precise effects of financialization on commodity markets. Theoretically, Basak and Pavlova (2016) and Goldstein and Yang (2021) show that the rapid increase in indexing activity should impact commodity prices and volatility. However, the empirical evidence remains mixed. Studies by Stoll and Whaley (2010) and Hamilton and Wu (2015) find no evidence of increased index flows affecting commodity prices or volatility. Conversely, Singleton (2014), Henderson, Pearson, and Wang (2015a), and Brogaard, Ringgenberg, and Sovich (2019) present evidence to the contrary.

Furthermore, financialization has influenced the informativeness of commodity prices. Goldstein and Yang (2021) demonstrate that as financialization grows, the noise introduced into commodity markets by financial hedgers becomes predominant, outweighing the positive effect of financial speculators on price efficiency, thus diminishing overall price informativeness. Similarly,

[8] Figure 3.3 visually demonstrates this surge in commodity investments, which the literature dates back to the beginning of 2004. The figure illustrates the total open interest in the cross-section of commodities expressed in both the number of outstanding contracts and dollar terms. Post-financialization (i.e., after 2004), total open interest spiked to record-high levels. This supports the literature's consensus in dating the financialization to the early 2004 period (refer to Basak and Pavlova (2016), Brogaard, Ringgenberg, and Sovich (2019), Goldstein and Yang (2021), among others).

Brogaard, Ringgenberg, and Sovich (2019) observe a reduction in commodity price informativeness in response to commodity financialization, though they attribute this effect to the index investing mechanism. An increasing number of empirical studies across other asset classes suggest that index investing, in general, leads to poorer price informativeness (and higher price volatility), as seen in studies such as Israeli, Lee, and Sridharan (2017), Ben-David, Franzoni, and Moussawi (2018), and Coles, Heath, and Ringgenberg (2022).

Our paper contributes to the ongoing debate by introducing a new perspective on how increased indexing in commodity markets has impacted their dynamics. Whereas the traditional debate has primarily focused on the impact of financialization on prices and volatility, our contribution centers on the returns generated by commodity strategies, which can be viewed as compensation for speculators. In response to commodity financialization, where commodity prices become less informative (Brogaard, Ringgenberg, and Sovich (2019) and Goldstein and Yang (2021)), the signals upon which many investment strategies rely may lose their overall informativeness, potentially compromising the profitability of these strategies. To the best of our knowledge, we are the first to explore the implications of commodity financialization for commodity futures trading strategies. This endeavor is particularly enlightening, given that most indexers who have entered this market since 2004 have done so under the assumption that commodity futures offer a risk premium to which one should unconditionally gain exposure.

2.3.2 Disentangling commodity futures portfolio returns

As is standard in the literature, we sort commodities based on the characteristics outlined in Section 2.2.2 and form long-short portfolios from the resulting extreme portfolios. The number of portfolios formed from the sorts and the definition of the long and short legs of each strategy follow the methodologies outlined in the referenced studies and is further detailed in Section 2.8 in the Internet Appendix.

Table 2.1 presents summary statistics for all the long-short commodity futures strategies under study. Across the entire sample, approximately 50% of the strategies exhibit statistically significant average returns at the 5% level, with an additional 15% showing significance at the 10% level (see Figure 2.5). We also observed that the long-short portfolios have similar volatilities for individual commodity futures. However, while Sharpe ratios of less than 0.25 are commonplace for individual commodities, Sharpe ratios for strategies that have at least a marginally significant return are higher than 0.25.[9]

When decomposing the return of the strategies into their pre- and post-financialization components, we observe a striking result. Among all the strategies with a significant average return over the entire sample, only Carry and Skewness remain significant in the post-financialization period (see Figure 2.6). In other words, about 80% of the commodity strategies that exhibit significance over the entire sample period seem to have generated their average return from a period before the current regime.[10]

For most of these strategies, the loss of statistical significance does not stem from an increase in volatility but rather from a reduction in average returns. This is an interesting fact to document, considering that the discussion in the literature regarding how financialization has impacted commodity markets has primarily focused on the price and volatility channels. Our findings suggest that the volatility of commodity futures strategies has remained relatively unchanged. However, the average returns they generate have experienced a significant deterioration. It is also worth pointing out that hedging pressure is the only strategy with an insignificant average excess return in the pre-financialization period but a significant return post-financialization. This is interesting because hedging pressure is a strategy with a strong theoretical foundation for why it should earn

[9] Figure 2.4 shows that the correlations among the strategies are generally not very high, except for some strategy pairs, such as momentum strategies. Additionally, when we conduct spanning tests of the return to each strategy on a constant and another strategy, we find that approximately 55% of the unique pairs deliver a statistically significant constant (see Table 2.6). This number is even higher if we exclude all those strategies that never deliver significant returns (e.g., *DollB* or *CvSzy*). This evidence highlights that the returns from the trading strategies tend to capture fairly different dynamics in the commodity futures markets.

[10] When moving the split date even just five years before the financialization of commodities markets (i.e., to January 1999), there are nearly as many strategies with average returns different from zero in the periods before and after the split date (see Table 2.7).

a risk premium in this asset class.

Therefore, Table 2.1 presents a novel empirical finding in the commodity futures literature: the returns to several commodity futures strategies fade away post-financialization. Thus, we demonstrate that the financialization of commodity futures markets, characterized by the influx of investment capital into this asset class, has impacted the market through a previously unexplored channel.[11] The sudden increase in passive investment capital into an asset can significantly depress average returns.

This effect of financialization is further illustrated in Figure 2.1, where we plot the difference in returns to the strategies post-financialization against the returns pre-financialization. The negative effect is evident for most of the strategies individually, with commodity anomalies exhibiting higher returns pre-financialization tending to show more pronounced declines in returns post-financialization.[12]

2.4 What explains the decay in average returns?

In this section, we shed light on the economic rationale behind the decline observed in average excess returns of commodity futures strategies post-financialization.

2.4.1 Systematic or idiosyncratic deterioration?

We begin by introducing and evaluating two main hypotheses aimed at elucidating the decline in returns of the commodity strategies around financialization.

First, it is plausible that the returns generated by the factors were primarily due to idiosyn-

[11]A decline in returns is also observed in other asset classes (namely, equity and forex) after the publication of trading strategies in academic literature. Therefore, one might worry that the decline in the returns to the commodity strategy we observe post-financialization might be capturing a similar phenomenon. In Section 2.5.1, we conduct robustness tests that rule out this potential alternative explanation.

[12]Figure 2.7 illustrates the evolution of trading strategies not previously applied in commodities by previous literature. As observed, most strategies in commodity markets experience a reduction in profitability post-financialization. Section 2.8 provides further details.

cratic mispricing. Therefore, as more investment capital flowed into the asset class, this mispricing was gradually eliminated. Second, we consider the possibility that a simple linear factor model adequately prices the cross-section of these commodity futures strategies. If this is indeed the case, the decline in returns must originate from more fundamental drivers of variation in the economy. Recent research, such as that by Kozak, Nagel, and Santosh (2018), suggests that the existence of a limited set of pricing factors implies that the returns to these strategies derive from a small set of underlying primitives. This still leaves the question of whether or not the primitives are driven by risk or behavioral factors.

To disentangle the two hypotheses, we employ a simple linear asset pricing factor model that does not take a stance on the nature of the pricing factors. Using the risk-premium principal component analysis (RP-PCA) technique introduced by Lettau and Pelger (2020), we extract latent factors from the cross-section of commodity futures portfolios. RP-PCA is a generalization of PCA designed to extract latent factors that simultaneously fit both the time series and the cross-section of expected returns. We examine the scree plot presented in Figure 2.2, which displays the first 15 eigenvalues to identify relevant factors. We observe three dominant factors and three weaker yet potentially significant factors. We select these six factors for further analysis.

To assess which hypotheses the evidence supports, we conduct Fama and MacBeth (1973) tests of the returns to commodity futures strategies on the first six RP-PCs over the entire sample period and two subsamples centered around financialization in 2004. This asset pricing approach operates on the principle that, in the absence of arbitrage opportunities, the Euler equation dictates that risk-adjusted returns on each zero-cost portfolio should average to zero. With excess returns to commodity portfolios denoted as R_t and a stochastic discount factor (SDF) represented as M_t, the following relationship should hold:

$$E[R_t M_t] = 0 \tag{2.2}$$

More specifically, an SDF that is linear in factors can be expressed as $M_t = 1 - (h_t - \mu_h)'b$, where h_t is the vector of pricing factors, b is a vector of factor loadings, and μ_t is a vector of the factor means. This SDF specification allows for a beta representation of the form:

$$E[R_{i,t}] = \lambda' \beta_i \tag{2.3}$$

where the risk premia to a particular strategy i depend on the price of risk (λ) and the strategy's loadings on the factors (β_i).[13] Thus, in our analysis, this corresponds to the regression coefficients of the excess returns to each commodity investment strategy on the (latent) risk factors, i.e., the RP-PCs. We estimate these coefficients using a standard Fama and MacBeth (1973) two-stage procedure, as commonly done in the literature.

Table 2.2 presents the results of the analysis. In Panel A, it is evident that the six latent factors can explain a substantial portion of the variation in average returns. As a result, the alpha in the second stage of the test is both statistically and economically indistinguishable from zero. This pattern persists when examining Panels B and C, representing the pre-financialization and post-financialization periods, respectively. These findings contradict the first hypothesis, suggesting that the strategies do not represent idiosyncratic mispricing that has been arbitraged away after financialization.

The analysis further reveals that a significant portion of the principal components (PCs) have experienced changes in risk premia post-financialization. Specifically, over 60% of the PCs have seen reductions in risk premia, with PC3 experiencing reductions exceeding 100% and PC2 experiencing reductions as small as 2%. PCs 5 and 6 have instead both experienced an increase. These results provide suggestive evidence in favor of hypothesis two, indicating that the most likely reason for the lack of significant average excess returns in almost all commodity futures strategies post-financialization is associated to adverse changes in the systematic primitives that drive them.[14]

[13] The relationship between the factor prices and the factor loadings is determined by the covariance matrix of the factors (Σ_h): $\lambda = \Sigma_h b$.

[14] It's worth noting that the results remain consistent even when considering a seven- or eight-latent factor model,

One may be worried that even though the joint tests show that the latent factor model explains all the variations in the commodity strategies we study, the same might not hold for individual asset pricing tests. To address this concern, we report the first stage Fama and MacBeth (1973) results in Table 2.8. These results confirm that the six-latent factor model adequately prices all twenty commodity futures factors in both the total sample and both sub-samples.

Figure 2.3 illustrates the ten-year rolling average of the latent factors, providing insights into their dynamics over time.[15] Notably, the dominant systematic factor (PC1) exhibits a trend of declining average returns. Before financialization, the average return of PC1 consistently exceeded 3%, but it has since trended toward a negative price of risk. In fact, the last ten-year average of this factor is currently negative. Additionally, the third latent factor (PC3) has experienced a significant deterioration in average returns. Lastly, the figure highlights changes in the price risk of PC6, which exhibited a marginally negative average return pre-financialization but has shown a significantly positive average return in the post-financialization period. These observations further underscore the impact of financialization on the dynamics of commodity futures markets.

Taken together, the results from the asset pricing test support the hypothesis that the influx of investment capital into the commodity futures market around 2004 is indeed associated with a deterioration in the returns to the strategies under study. Furthermore, this reduction occurred through the influence of a handful of systematic factors that the strategies load on.[16]

as additional RP-PCs exhibit limited explanatory power across all subsamples and lack significant price of risk (see Table 2.9).

[15] Using total open interest as a proxy for flows, Figure 3.3 shows that the flows of capital into the commodity futures market kept increasing even after the large sudden spike around the financialization.

[16] This finding underscores the significance of these systematic factors in driving variations in the returns of commodity futures strategies. Given that this is a new factor model in the cross-section of commodities, further characterization of these latent factors can provide additional insights into their properties and their role in shaping commodity market dynamics. Thus, in the Appendix 2.8, we take the opportunity to characterize some of their properties better.

2.4.2 Index flow channel

Next, we delve into index investing as a potential channel behind the observed systematic deterioration in average excess returns of commodity futures strategies post-financialization. We utilize data on constituents of the Dow Jones Commodity Index and their weights, sourced from Standard & Poor's, spanning from January 2000 onwards.

To test this potential mechanism, we employ the following baseline specification:

$$R_{i,t+1} = \alpha_i + \beta_1 D_{i,t} + \Gamma D_{i,t} * \delta_t + e_{i,t+1}. \tag{2.4}$$

where: i) $R_{i,t+1}$ represents the returns to commodity investment strategy i, ii) α_i is a dummy capturing strategy fixed effects, iii) $D_{i,t}$ is a dummy variable that takes the value one if strategy i at time t has exposure to any commodity in the top-3 weighted commodities in the DJCI index[17], and iv) $D_{i,t} * \delta_t$ is a dummy that, at time t, is equal to one for all strategies that have exposure to a commodity whose weight is in the top-3 of the index. This last term, interpreted as an "exposure by time fixed effects" indicator, allows us to control for the increasing inflows of capital into the commodity markets (and, therefore, into the commodities index) over time. This variable also absorbs variation coming from other potential time-varying confounding omitted effects that impact index-exposed and non-index-exposed strategies differently.

The results of these tests are presented in Table 2.3. The coefficient of interest, β_1, captures the average effect on the returns to the strategies of trading commodities with high weights in the commodity index. As observed in column (1), exposure to the index has a significant negative effect on the average returns of a strategy. Specifically, a commodity investment strategy experiences about a 70 basis points drop in returns whenever it trades commodities with top-3 weight in the DJCI.

[17]The top-3 weighted commodities at each point in time, alone, account on average for around 40% of the overall DJCI weights. The weights of commodities in the index precipitously fall off, such as the highest weighted commodity at each point in time is, on average, almost four times larger than the average weight of the third highest weighted commodity.

Furthermore, column (2) repeats the analysis with the inclusion of an open interest variable as a control, capturing additional omitted effects of the increasing capital inflows not perfectly captured by the coefficients Γ. Similarly, column (3) includes a dollar open interest variable, i.e., open interest multiplied by the spot price. Overall, the results remain robust to the inclusion of these additional controls.

In summary, the findings indicate that index flow, and therefore index investing, is a fundamental channel through which financialization has impacted commodity futures strategies.

2.5 Robustness tests

In this section, we test and rule out alternative explanations for the observed decay in returns to the strategies under study.

2.5.1 Financialization versus academic research

Thus far, we have argued that financialization is associated with declining returns to commodity futures strategies. However, a plausible alternative narrative is that the publication of these strategies in academic journals may trigger this decline, independent of financialization. This is a compelling alternative because most strategies under examination were published post-financialization. To investigate this possibility, we adopt an approach akin to McLean and Pontiff (2016) in equity and Bartram et al. (2023) in forex. Formally, we run variations of the following baseline specification to assess this alternative hypothesis:

$$R_{i,t} = \alpha_i + \beta_1 \textit{Post-Financialization Dummy}_{i,t} + \beta_2 \textit{Post-Publication Dummy}_{i,t} + e_{i,t}. \qquad (2.5)$$

Table 2.4 presents the results, with standard errors for all the tests clustered on time. Specifically, in our first test, we regress the returns to all the strategies we study on a dummy variable that takes the value zero before January 2004 (i.e., pre-financialization) and one afterward (i.e., post-financialization). The estimated coefficient on the dummy variable for this specification is negative and statistically significant, confirming the findings from our portfolio sorts that the returns to the trading strategies decay post-financialization. Specifically, starting from 2004, the average returns to a typical commodity futures strategy have declined by about 51 basis points per month. The pre-financialization average returns of the strategies are approximately 78 basis points per month.

In the second test, we regress the returns to the commodity strategies on a dummy that takes the value zero before the publication date of a strategy and one afterward. While previous literature has documented a decrease in returns to trading strategies post-academic publication in equity and forex markets, the dynamics in commodities have not been analyzed yet. The estimated coefficient from this second specification is similarly negative and significant. Hence, the result suggests that the typical commodity strategy has also experienced a return decay after the strategy was published in an academic journal, quantifiable at around 46 basis points per month.

To disentangle which of these two alternatives drives what fraction of the decay, we regress the returns to the strategies on two dummies. The first dummy takes the value of zero before financialization and one afterward. The second takes the value of zero before publication in the academic literature and one afterward. We report the results as specification 3 in the table. As is evident, the post-financialization dummy subsumes the post-publication dummy. After financialization, the average commodity strategy has lost about 44 bps per month on average. After publication, the strategies lost an additional 14 bps on average, although the estimate is statistically insignificant. Therefore, the results of this test strongly suggest that the financialization of commodity markets is associated with the most decay in returns rather than the publication of the strategies.

To verify the robustness of this conclusion, we run a fourth specification where the post-financialization dummy takes a value of zero before financialization and after publication and a one in-between. The publication dummy takes a value of one after publication. This allows us to strongly isolate the financialization effect. The results in specification (4) confirm the findings from specification (3) regarding the financialization effect.[18]

Overall, around 75% of the observed decay in returns to commodity strategies can be attributed to the financialization of the market, with the remaining portion stemming from the publication of the strategies in the academic literature.

2.5.2 Potentially confounding periods after the financialization

To address potential concerns regarding the influence of the global financial crisis (GFC) and the COVID-19 pandemic on commodity futures strategy dynamics, we repeat the baseline analysis but exclude the GFC years (2007 to 2009) and the COVID-19 year (2020) from our sample.[19]

Our analysis indicates that the key findings remain qualitatively consistent. As depicted in Table 2.15, we continue to observe a decline in the returns to most commodity strategies post-financialization. This evidence corroborates the idea that the return deterioration is associated with systematic dynamics related to the financialization of commodity futures markets. To further reinforce the robustness of our findings, it is worth mentioning that in a specification similar to column (1) of Table 2.4, the magnitude of the post-financialization dummy remains significant, indicating a decay of approximately 50 basis points per month. In other words, the average returns to a typical commodity futures strategy have deteriorated by about 50 basis points per month after financialization, even when the GFC and COVID periods are removed from our sample.

2.6 Conclusions

In this paper, we investigate the impact of financialization and the growth of indexing on the average returns to commodity futures investment strategies. We show that of the thirteen com-

[18] Additionally, if we regress the returns on the stock market on the financialization dummy, the estimated coefficient is small but positive. However, including the returns to the market as a control in the specifications in Table 2.4 does not affect the results. This evidence suggests that the behavior of the overall market does not seem to explain our findings. The results of these additional tests are available upon request.

[19] However, it is important to note that by omitting the early years of the financial crisis, we may also remove some dynamics stemming from the late part of the financialization that occurred during that period.

modity futures strategies with a significant average return before the financialization of commodity markets, only three remain profitable afterward. We find that this decline in strategy returns is primarily associated with a dramatic fall in the average returns of the systematic factors driving expected returns in this asset class.

Our findings offer compelling evidence supporting the notion that the financialization of commodity markets and indexing has impacted certain commodity market participants. Our results align with the model of Sockin and Xiong (2015), in which information frictions hinder commodity futures market participants from effectively utilizing price and volume data to make profitable investment choices.

2.7 Tables and Figures

Table 2.1: Descriptive Statistics - Returns to the Commodity Investment Strategies (Over Subsamples)

This table reports the returns to the commodity investment strategies built on the characteristics described in Section 2.2.2. The construction of the excess returns takes into account the first notice day convention following Bakshi, Gao, and Rossi (2019). We build end-of-month series for commodity returns from March 1986 to August 2021. These data are collected from CRB, Datastream, and Factset. The left panel reports the statistics for the returns to the strategies over the full sample of data (03/1986 to 08/2021). While, the middle and right panels report the descriptive statistics for the strategies, respectively, over the pre- and post-financialization periods, where the sample is split around January 2004. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). The data for the sorting variables are retrieved from different sources, as reported in the separate Appendix 2.8, which also describes how the strategies are constructed. *Inventory* is available only up to beginning of 2011. Average returns (*Mean*) and standard deviations (*Std*) are annualized in percentage. *SR* refers to the Sharpe ratio. We compute test statistics (*tstat*) using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level.

Full Sample					Pre-Financialization					Post-Financialization				
Factor	Mean%	Std%	SR	tstat	Factor	Mean%	Std%	SR	tstat	Factor	Mean%	Std%	SR	tstat
Carry***	14.82	18.76	0.79	4.81	Carry***	18.49	20.64	0.90	3.95	Carry***	11.10	16.62	0.67	2.69
Skewn***	13.86	20.83	0.67	4.00	Skewn*	10.63	22.89	0.46	1.89	Skewn***	17.14	18.52	0.93	4.13
BaMom***	13.13	25.29	0.52	2.84	BaMom***	18.77	25.77	0.73	3.17	BaMom	7.42	24.74	0.30	1.08
Inven**	-7.19	13.93	-0.52	-2.55	Inven**	-8.30	14.26	-0.58	-2.36	Inven	-4.37	13.07	-0.33	-0.94
CVDhu**	7.51	17.34	0.43	2.54	CVDhu***	14.56	17.69	0.82	3.76	CVDhu	0.35	16.77	0.02	0.09
Mom06**	9.14	23.97	0.38	2.48	Mom06**	11.98	25.93	0.46	2.05	Mom06	6.27	21.83	0.29	1.40
Mom01**	10.23	25.05	0.41	2.39	Mom01**	14.28	26.28	0.54	2.34	Mom01	6.12	23.74	0.26	1.11
Volat**	8.35	23.43	0.36	2.34	Volat***	18.33	25.03	0.73	3.89	Volat	-1.82	21.34	-0.09	-0.36
MoB12**	10.24	28.67	0.36	2.16	MoB12***	18.85	31.26	0.60	2.63	MoB12	1.51	25.61	0.06	0.27
Mom03**	8.83	24.41	0.36	2.08	Mom03**	13.84	25.27	0.55	2.25	Mom03	3.75	23.48	0.16	0.69
InflB*	7.07	21.80	0.32	1.85	InflB	5.10	19.98	0.26	1.09	InflB	9.06	23.54	0.38	1.54
Averg*	4.53	12.00	0.38	1.81	Averg***	5.77	9.47	0.61	2.58	Averg	3.27	14.12	0.23	0.77
Rever*	6.07	22.32	0.27	1.68	Rever**	11.58	23.02	0.50	2.25	Rever	0.47	21.51	0.02	0.09
DollB	-4.67	19.71	-0.24	-1.41	DollB	-2.29	18.81	-0.12	-0.50	DollB	-7.09	20.60	-0.34	-1.48
Mom12	4.83	21.37	0.23	1.38	Mom12**	12.22	22.92	0.53	2.40	Mom12	-2.67	19.50	-0.14	-0.61
HedPr	3.83	18.17	0.21	1.26	HedPr	-0.66	18.24	-0.04	-0.15	HedPr**	8.38	18.04	0.46	2.15
CVSzy	3.78	17.55	0.22	1.18	CVSzy	5.23	19.33	0.27	1.08	CVSzy	2.32	15.57	0.15	0.58
Basis	2.57	25.74	0.10	0.58	Basis	5.40	27.94	0.19	0.78	Basis	-0.31	23.33	-0.01	-0.06
OpeIn	-1.33	18.20	-0.07	-0.43	OpeIn	0.19	21.03	0.01	0.04	OpeIn	-2.89	14.83	-0.19	-0.87
Liqui	-0.60	15.57	-0.04	-0.20	Liqui	-0.15	16.02	-0.01	-0.04	Liqui	-1.05	15.14	-0.07	-0.27
Value	0.59	18.14	0.03	0.18	Value	-0.05	18.40	0.00	-0.01	Value	1.24	17.91	0.07	0.29

Table 2.2: Unconditional Asset Pricing Tests (Over Subsamples) - Second Stage Regressions
This table reports the results for the second (cross-sectional) stage of the Fama and MacBeth (1973) asset pricing tests. We use as test assets the returns to the commodity investment strategies presented in Table 2.1; while, the six candidate factors are the six RP-PCs extracted as in Lettau and Pelger (2020). *Panel A* reports the results for the test conducted over the full sample (i.e., 03/1986 to 08/2021); while, *Panel B* and *Panel C* report the results for the tests conducted, respectively, over the pre- and post-financialization periods, where the sample is split around January 2004. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). Mean (*Mean*) and prices of risk (*RP*) for each latent factor (the RP-PCs), as well as for the estimated intercepts, are reported in annualized percentage points. We compute test statistics (*tstat*) using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). Cross-sectional R^2 are in percentage points. The risk premium parameter of the Lettau and Pelger (2020) procedure is set equal to 10. The sample is monthly from March 1986 to August 2021. Results for the first (time-series) stage of the asset pricing tests are reported in Table 2.8 in the Appendix.

Panel A	Full Sample						
Factors	Intercept	PC1	PC2	PC3	PC4	PC5	PC6
Mean (%)		30.77	15.71	5.76	0.39	4.26	4.37
RP (%)	0.84	27.94	14.09	4.38	0.92	3.47	4.79
$tstat_{nw}$	[0.77]	[3.41]	[3.31]	[0.78]	[0.22]	[0.83]	[1.09]
$tstat_{sh}$	[0.81]	[3.18]	[2.74]	[0.86]	[0.20]	[0.82]	[1.19]
R2 (%)		33.69	78.58	84.26	84.22	87.30	90.47

Panel B	Pre-Financialization						
Factors	Intercept	PC1	PC2	PC3	PC4	PC5	PC6
Mean (%)		46.09	15.67	14.51	0.99	2.25	-5.55
RP (%)	0.45	44.04	13.40	13.69	1.55	0.97	-6.07
$tstat_{nw}$	[0.45]	[3.80]	[2.70]	[1.76]	[0.36]	[0.14]	[-1.12]
$tstat_{sh}$	[0.31]	[3.24]	[1.79]	[1.87]	[0.25]	[0.16]	[-1.03]
R2 (%)		40.24	59.24	80.28	80.40	80.56	84.75

Panel C	Post-Financialization						
Factors	Intercept	PC1	PC2	PC3	PC4	PC5	PC6
Mean (%)		15.88	15.30	-3.29	-0.42	5.96	14.26
RP (%)	1.39	11.55	12.29	-5.31	-0.06	5.76	14.26
$tstat_{nw}$	[0.89]	[1.42]	[1.84]	[-0.80]	[-0.01]	[1.24]	[2.61]
$tstat_{sh}$	[1.06]	[1.07]	[1.73]	[-0.76]	[-0.01]	[0.98]	[2.60]
R2 (%)		6.31	39.63	41.28	41.30	47.89	77.64

Table 2.3: Index Flow Mechanism

This table reports the results from regressions of the returns to the commodity strategies (in percentage per month) on a dummy variable that takes value one if the futures strategy-i at time-t has exposure to any commodity in the top-3 weighted commodities in the index, and a dummy that at t is equal to one for all strategies that have at least a commodity with top-3 exposure to the index. All regressions include factor fixed effects. Column (1) reports the results when restricting the commodities to have top-3 weights in the DJCI Index over the (monthly) period 01/2004 to 08/2021 (i.e., the post-financialization period). Column (2) repeats the same exercise but adding open interest as a control variable; while, Column (3) adds dollar open interest as a control variable. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). Standard errors are clustered on time. Cross-sectional R^2 are in percentage points. We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level.

	Factors		
	(1)	(2)	(3)
$D_{i,t}$	-0.707***	-0.568*	-0.549**
Observations	4139	4139	3933
Factor Fixed Effects	Yes	Yes	Yes
Exposure by Time Fixed Effects	Yes	Yes	Yes
Control for Open Interest	No	Yes	No
Control for Dollar Open Interest	No	No	Yes

Table 2.4: Regression of Factors on Post-Financialization and Post-Publication Indicators

This table reports the results from regressions of the returns to the commodity strategies (in percentage per month) on a dummy variable for the post-financialization period, a dummy variable for the period between financialization and the publication of the factor, and a dummy variable for the post-publication period. *Post-Financialization* is equal to one if the month is after the financialization of commodity markets (i.e., post 01/2004) and zero otherwise. *Post-FinaToPublication* is equal to one if the month is after the financialization of commodity markets (i.e., post 01/2004) but before the official publication date, and zero otherwise. *Post-Publication* is equal to one if the month is after the official publication date and zero otherwise. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). The data contain monthly series from March 1986 to August 2021. Regressions include factor fixed effects as indicated in the table. Standard errors are clustered on time. We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. The mean factor return pre-financialization is 0.784 (i.e. 78.4 bps per month).

	Factors			
	(1)	(2)	(3)	(4)
Post-Financialization	-0.511**		-0.438**	
Post-FinaToPublication				-0.437**
Post-Publication		-0.460**	-0.144	-0.577**
Observations	8,499	8,499	8,499	8,499
Factor Fixed Effect	Yes	Yes	Yes	Yes

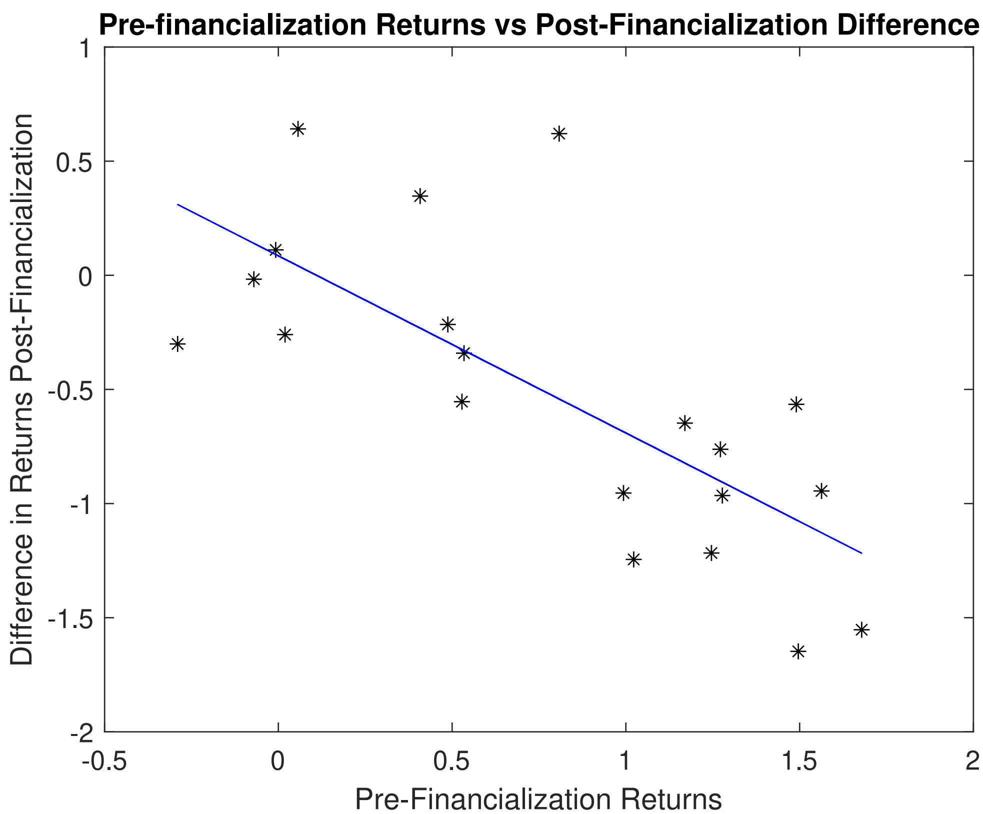

Figure 2.1: Relation between pre- and post-financializtion returns

This scatter plot shows the relation between the monthly returns to the 20 commodity trading strategies pre-financialization and the changes in their returns post-financialization. The returns pre-financialization are mean monthly excess returns in percentage points (i.e., % per month). Changes in returns post-financialization are instead the difference of the mean monthly excess returns in percentage points between post-financialization and pre-financialization returns. The sample period covers monthly data from March 1986 to August 2021. The commodity investment strategies are described in Section 2.8 of the Appendix and their performance across the different subsamples (Full Sample, Pre- and Post-Financialization periods) is analyzed in Table 2.1.

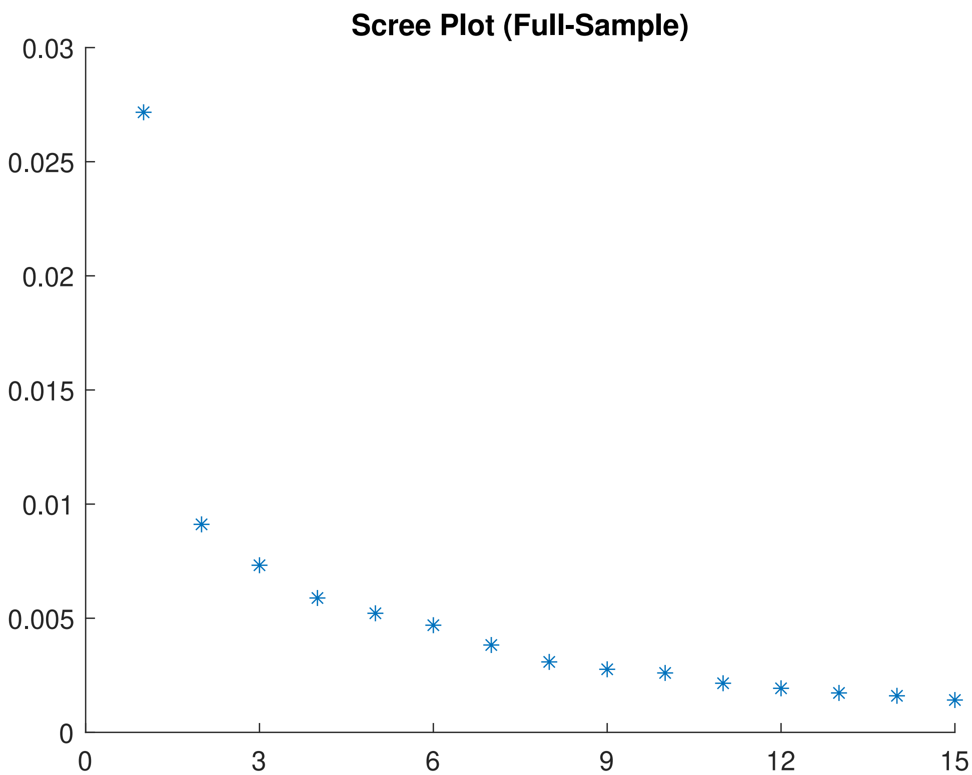

Figure 2.2: First 15 eigenvalues

This figure plots the first 15 eigenvalues of the data, arising from the application of the RP-PCA methodology (Lettau and Pelger (2020)) to the returns to the commodity investment strategies. The sample period covers monthly data from March 1986 to August 2021.

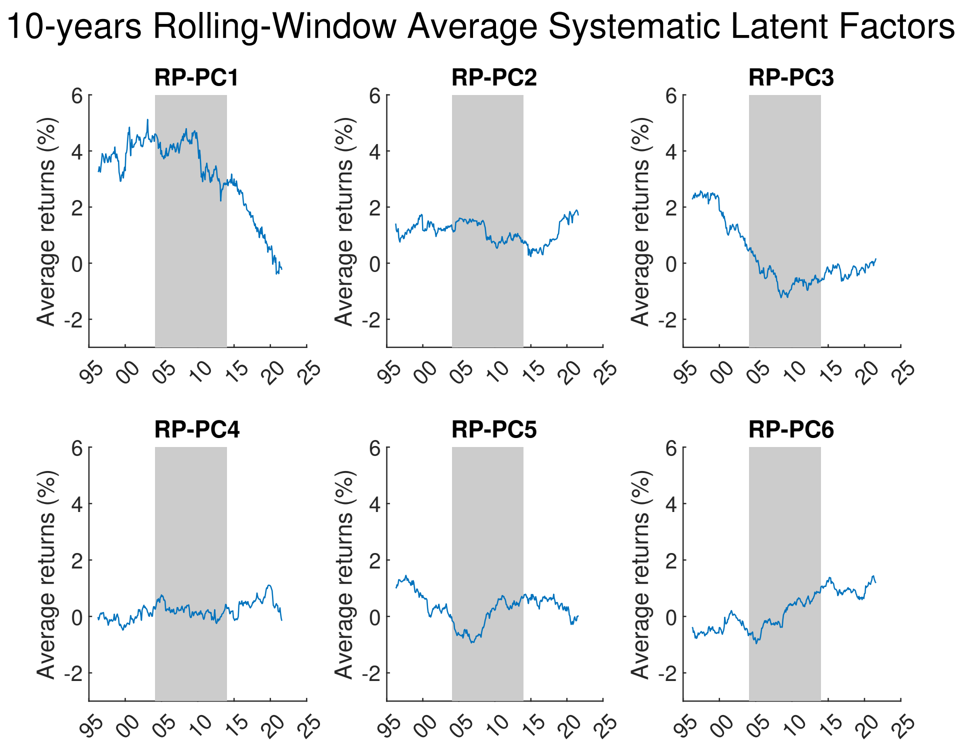

Figure 2.3: Rolling-window average latent factors

This figure plots the ten-year rolling average return of each RP-PC in our six factor model. The grey rectangle starts at January 2004 (the financialization date) and ends in December 2013. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). The sample period covers monthly data from March 1986 to August 2021.

2.8 Appendix

Descriptive Statistics - Individual Commodities

Table 2.5: **Descriptive Statistics - Excess Returns to Individual Commodities**
This table reports the descriptive statistics of the individual commodity futures excess returns computed as in equation (1). For each commodity, we report the annualized average returns (*Mean*), annualized standard deviation (*Std*), annualized Sharpe Ratios (*SR*) and the skewness (*Skew*) of the monthly returns, as well as the number of observations (N). The construction of the excess returns takes into account the first notice day convention following Bakshi, Gao, and Rossi (2019). We build end-of-month series for commodity returns from March 1986 to August 2021. These data are collected from CRB, Datastream, and Factset.

	Mean %	Std %	SR	Skew	N
Crude oil	10.50	35.88	0.29	0.45	425
Gasoline	22.32	39.63	0.56	0.28	425
Heating oil	13.96	35.98	0.39	0.85	425
Natural gas	-8.04	47.14	-0.17	0.60	375
Gas-oil petroleum	10.87	33.09	0.33	0.21	383
Propane	27.20	64.15	0.42	7.30	263
Rough rice	-4.20	25.82	-0.16	1.02	416
Sugar	6.14	30.70	0.20	0.30	425
Corn	-2.96	25.91	-0.11	0.72	425
Oats	2.47	32.80	0.08	2.37	425
Wheat	-2.56	26.33	-0.10	0.42	425
Canola	1.72	20.79	0.08	0.08	422
Barley	0.87	20.12	0.04	0.29	278
Cotton	2.34	25.70	0.09	0.24	425
Lumber	0.42	32.87	0.01	0.70	425
Rubber	3.46	36.46	0.09	0.44	354
Feeder cattle	3.80	14.28	0.27	-0.13	425
Live cattle	2.48	13.69	0.18	-0.44	425
Lean hogs	-0.35	25.26	-0.01	-0.27	425
Pork bellies	4.06	37.65	0.11	0.56	304
Gold	2.73	15.30	0.18	0.17	425
Silver	4.40	27.92	0.16	0.38	425
Copper	12.07	25.79	0.47	0.17	425
Palladium	14.28	30.92	0.46	0.38	421
Platinum	4.83	21.89	0.22	-0.03	425
Soybeans oil	0.42	23.85	0.02	0.19	425
Soybeans meal	10.10	25.35	0.40	0.44	425
Soybeans	4.69	22.78	0.21	-0.02	425
Coffee	-2.83	35.67	-0.08	1.09	425
Orange juice	0.52	29.67	0.02	0.52	425
Cocoa	-1.67	27.77	-0.06	0.44	425
Milk	5.70	28.87	0.20	1.05	303

Variables Construction

1. Level (*Averg*): We follow Bakshi, Gao, and Rossi (2019) in constructing the level factor (i.e. the average factor) as the excess returns of a strategy that goes long in all the available commodity futures.

2. Carry (*Carry*): We follow Bakshi, Gao, and Rossi (2019) in constructing carry by sorting on the log of the slope of the futures curve (i.e. $log(y_t)$, with $y_t = \frac{F_t^{(1)}}{F_t^{(0)}}$) and in allocating commodities into 4 portfolios. Hence, commodities are sorted from most in contango (highest $ln(y_t) > 0$) to most backwardated (lowest $ln(y_t) > 0$).

3. Basis (*Basis*): We follow Boons and Prado (2019) in constructing basis by sorting on $B_t = \frac{(F_t^{(2)} - F_t^{(1)})}{F_t^{(1)}}$ and allocating commodities into 3 portfolios. The High (respectively, Low) portfolio contains the four commodities with the highest (respectively, lowest) ranked signal, while the Medium portfolio contains all remaining commodities.

4. Momentum 1-months (*Mom01*): We follow Miffre and Rallis (2007) in constructing momentum by sorting on the returns over the previous one-month. Commodities are then allocated in 5 portfolios.

5. Momentum 3-months (*Mom03*): We follow Miffre and Rallis (2007) in constructing momentum by sorting on the returns over the previous three-months. Commodities are then allocated in 5 portfolios.

6. Momentum 6-months (*Mom06*): We follow Bakshi, Gao, and Rossi (2019) in constructing momentum by sorting on the past six-month performance. Commodities are then allocated in 5 portfolios.

7. Momentum 12-months (*Mom12*): We follow Szymanowska et al. (2014) in constructing (long-term) momentum by sorting on the cumulative log return from month $t-12$ to $t-1$ and allocating commodities into 4 portfolios.

8. Momentum 12-months (*MoB12*): We follow Boons and Prado (2019) in constructing (long-term) momentum by sorting on the cumulative log return from month $t-11$ to t and allocating commodities into 3 portfolios. The High (respectively, Low) portfolio contains the four commodities with the highest (respectively, lowest) ranked signal, while the Medium portfolio contains all remaining commodities.

9. Reversal (*Rever*): Bianchi, Drew, and Fan (2015) show that a consistent reversal pattern is pronounced from month 12 to 30. We construct the contrarian strategy on a signal based on portfolio formation months 36-13, and allocate commodities into 5 portfolios.

10. Basis-Momentum (*BaMom*): We follow Boons and Prado (2019) in constructing basis-momentum by sorting on:
$$BM_t = \prod_{j=t-11}^{t} (1 + R_j^{(1)}) - \prod_{j=t-11}^{t} (1 + R_j^{(2)})$$
i.e. on the momentum between two consecutive nearby futures strategies and allocating commodities into 3 portfolios. The High (respectively, Low) portfolio contains the four commodities with the highest (respectively, lowest) ranked signal, while the Medium portfolio contains all remaining commodities.

11. Coefficient of variation using spot prices (*CVDhu*): We follow Dhume (2010) in constructing the coefficient of variation as the variance of the past three months daily spot prices scaled by their mean. Commodities are then allocated into 5 portfolios using the demeaned values (where the mean is computed over the previous 60 months).

12. Coefficient of variation using returns (*CVSzy*): We follow Szymanowska et al. (2014) in constructing the coefficient of variation as the variance on the past daily returns scaled by the mean return and allocating commodities into 4 portfolios.

13. Volatility (*Volat*): We follow Gorton, Hayashi, and Rouwenhorst (2013) in constructing volatility as the square root of the average squared daily excess returns of the month over

which the excess return is calculated, multiplied by the square root of 365. Thus, this measure is forward-looking. Moreover, volatility is demeaned at the commodity level. We allocate commodities into 4 portfolios.

14. Inventory (*Inven*): We refer the interested reader to Section 3.2 and Appendix B of Gorton, Hayashi, and Rouwenhorst (2013) for how this variable is constructed. Our data end at the beginning of 2011. Following their paper, commodities are allocated into 2 portfolios.

15. Hedging pressure (*HedPr*): We follow Szymanowska et al. (2014) and Basu and Miffre (2013) in constructing hedging pressure (for hedgers) as the difference between the number of short and long hedge positions by large traders in proportion to the total number of hedge positions by large traders in that market:

$$hp_t = \frac{\#\text{short hedge positions} - \#\text{long hedge positions}}{\text{total } \# \text{ hedge positions}}$$

The positions are measured by the number of contracts in the market. The data are retrieved from the Commitment of Traders reports issued by the Commodity Futures Trading Commission (CFTC). Commodities are then allocated into 4 portfolios.

16. Open interest (*OpeIn*): We follow Hong and Yogo (2012) in constructing open interest as the total open interest in futures market. We allocate commodities into 4 portfolios. The data are retrieved from the Commitment of Traders reports issued by the Commodity Futures Trading Commission (CFTC).

17. Liquidity (*Liqui*): We follow Marshall, Nguyen, and Visaltanachoti (2012) and Marshall, Nguyen, and Visaltanachoti (2013) in constructing liquidity as the Amivest measure for liquidity of Amihud, Mendelson, and Lauterbach (1997), i.e. as the volume on a trading day divided by the absolute value of the daily return. We allocate commodities into 4 portfolios.

18. Value (*Value*): We follow Asness, Moskowitz, and Pedersen (2013) in constructing value as

the log of the spot price 5 years ago (actually, of the average spot price from 4.5 to 5.5 years ago) divided by the most recent spot price and allocating commodities into 3 portfolios. Hence, value can be seen as the negative of the spot return over the last 5 years.

19. Inflation-β (*InflB*): we sort commodities based on the betas estimated from a 60-month rolling window regression of monthly commodity futures returns on changes in one-month CPI inflation. We then allocate commodities into 4 portfolios (see also Szymanowska et al. (2014)).

20. Dollar-β (*DollB*): we sort commodities based on the betas estimated from a 60-month rolling window regression of monthly commodity futures returns on changes in a broad US dollar index. We then allocate commodities into 4 portfolios (see also Szymanowska et al. (2014)).

21. Skewness (*Skewn*): We follow Fernandez-Perez et al. (2018) in constructing skewness by sorting on the coefficient of skewness of the daily commodity returns from month $t - 11$ to t. We allocate commodities into 5 portfolios.

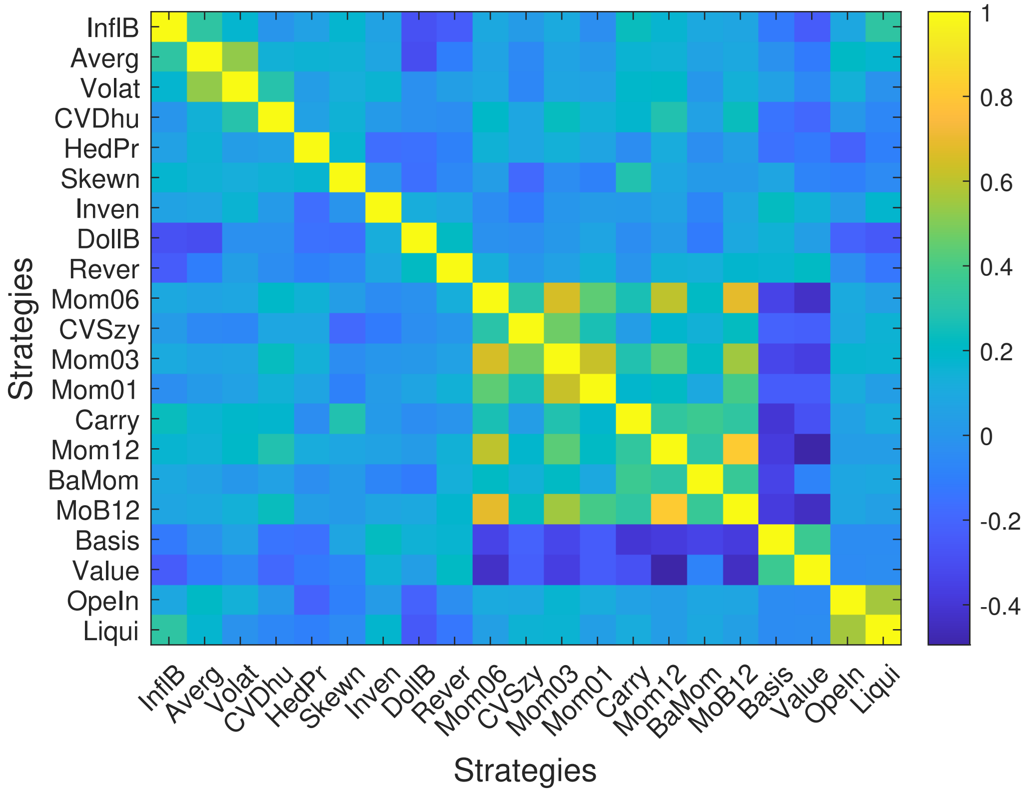

Figure 2.4: Correlation matrix of the commodity investment strategies (Full Sample)

This heatmap shows the correlation matrix of the commodity trading strategies. The sample period covers monthly data from March 1986 to August 2021. The commodity investment strategies are described in Section 2.8 of the Appendix and their performance across the different subsamples (Full Sample, Pre- and Post-Financialization periods) is analyzed in Table 2.1.

Correlation Matrix of the Commodity Trading Strategies

Average Returns to the Commodity Trading Strategies (Across Subsamples)

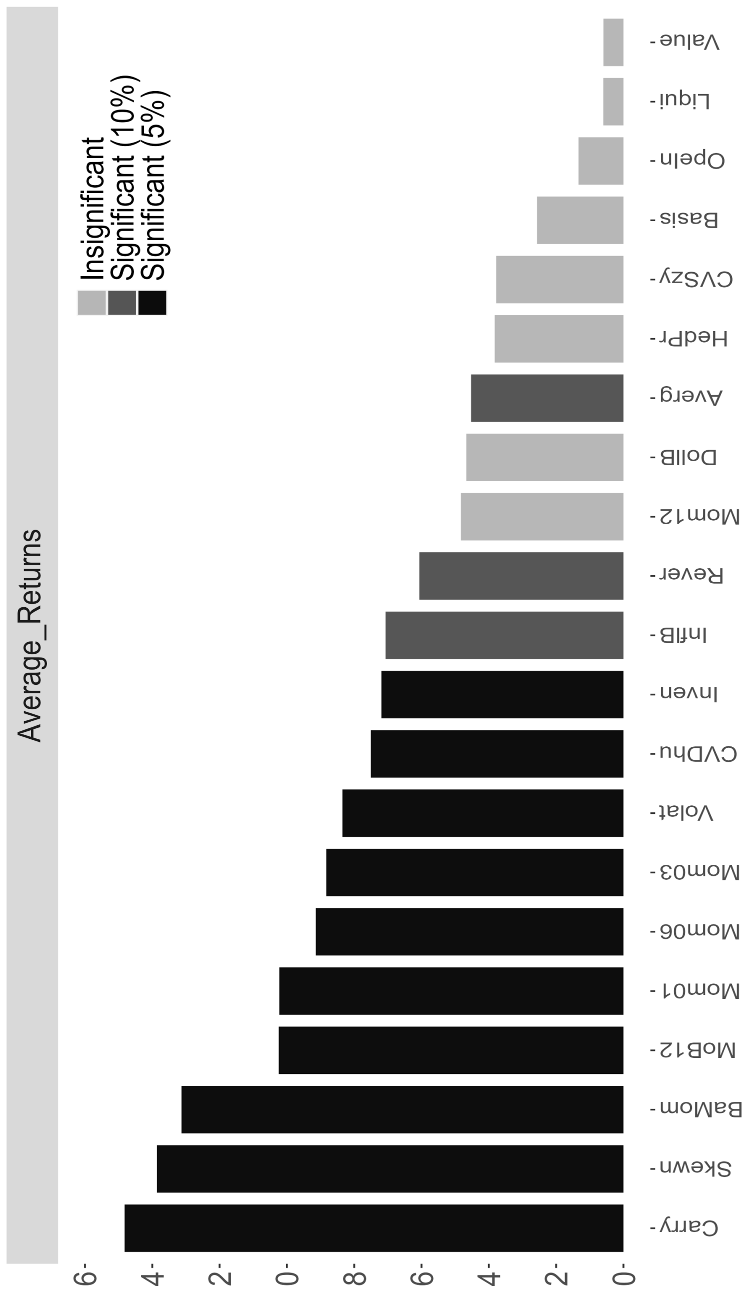

Figure 2.5: Average returns to the commodity investment strategies (Full Sample)

This histogram shows the average returns to each of the commodity trading strategies. The returns are annualized excess returns in percentage points. The sample period covers monthly data from March 1986 to August 2021. Black and dark grey bars represent, respectively, strategies that deliver returns significant at the 5% and 10% significant level; while, light grey bars represent strategies that deliver average returns not statistically significant. The commodity investment strategies are described in Section 2.8 of the Appendix and their performance across the different subsamples (Full Sample, Pre- and Post-Financialization periods) is analyzed in Table 2.1.

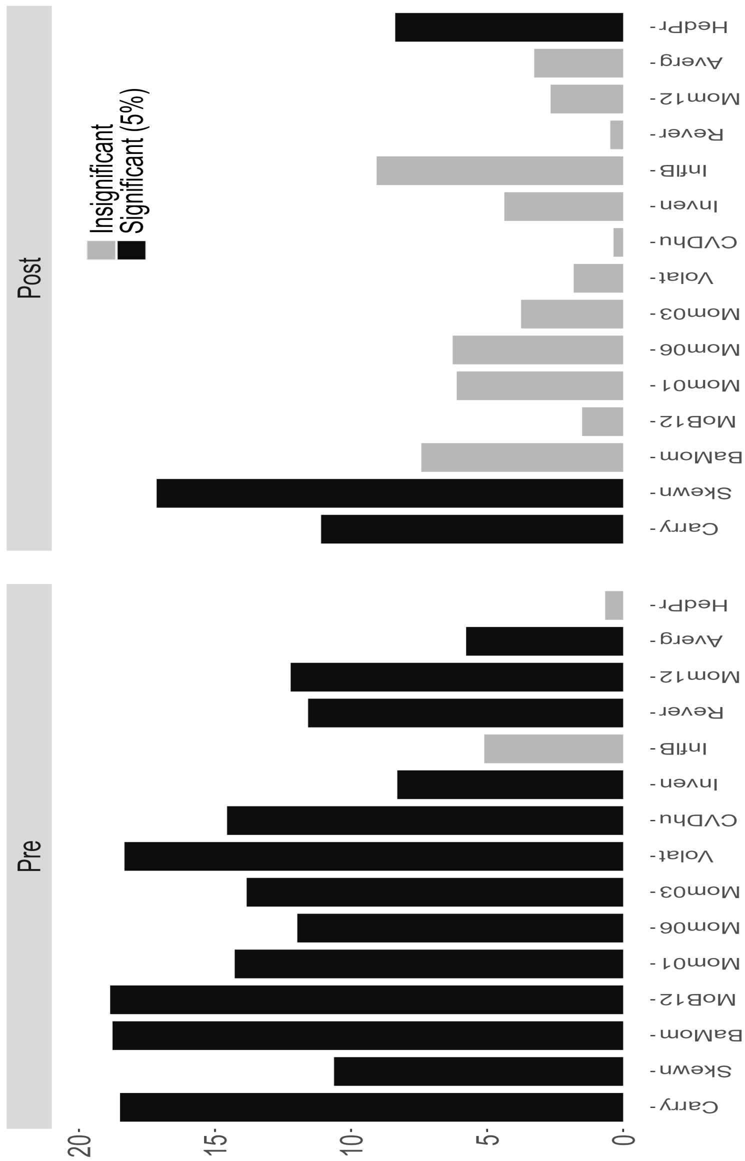

Figure 2.6: Average returns to the commodity investment strategies (Pre and Post-Financialization)

This histogram shows the average returns to each of the commodity trading strategies. The returns are annualized excess returns in percentage points. The sample period covers monthly data from March 1986 to August 2021. The left and right panels report the average the returns to the strategies, respectively, over the pre- and post-financialization periods (where the sample is split around January 2004). The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). Black and dark grey bars represent, respectively, strategies that deliver returns significant at the 5% and 10% significant level; while, light grey bars represent strategies that deliver average returns not statistically significant. The commodity investment strategies are described in Section 2.8 of the Appendix and their performance across the different subsamples (Full Sample, Pre- and Post-Financialization periods) is analyzed in Table 2.1.

Spanning Tests

Table 2.6: Spanning Tests (T-Statistics of the Intercepts)

This table displays the t-statistics of the intercepts resulting from regressions of the returns to each strategy on a constant and another strategy. We compute test statistics (*tstat*) using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). The commodity investment strategies are described in Section 2.8 of the Appendix and their performance across the different subsamples (Full Sample, Pre- and Post-Financialization periods) are analyzed in Table 2.1. The data contain monthly series from March 1986 to August 2021.

	Averg	Carry	Mom06	Mom12	InflB	DollB	CVSzy	CVDhu	HedPr	BaMom	MoB12	Basis	Volat	Value	Inven	Skewn	OpeIn	Liqui	Mom03	Mom01	Rever
Averg	0.00	1.13	1.72	1.64	1.30	1.49	1.89	1.48	1.66	1.52	1.60	1.82	0.93	1.89	2.27	1.31	1.95	1.83	1.74	1.81	1.95
Carry	1.13	0.00	4.36	4.76	4.82	4.79	4.55	4.50	4.79	3.80	4.34	5.71	4.88	5.22	4.19	3.75	4.87	4.96	4.26	4.46	4.92
Mom06	1.72	4.36	0.00	1.82	2.32	2.49	2.21	2.00	2.23	1.84	0.96	2.76	2.33	2.87	2.73	2.46	2.57	2.50	1.09	1.25	2.23
Mom12	1.64	4.76	1.82	0.00	1.06	1.45	1.23	0.67	1.21	0.38	-0.73	1.67	1.07	1.76	2.53	1.01	1.40	1.40	0.47	0.87	1.16
InflB	1.30	4.82	2.32	1.06	0.00	1.48	1.84	1.79	1.80	1.48	1.75	1.93	1.52	2.01	1.44	1.22	1.89	1.93	1.70	2.01	2.37
DollB	1.49	4.79	2.49	1.45	1.48	0.00	-1.38	-1.34	-1.24	-1.01	-1.57	-1.54	-1.42	-1.43	-0.55	-0.81	-1.53	-1.45	-1.48	-1.59	-1.78
CVSzy	1.89	4.55	2.21	1.23	1.84	-1.38	0.00	1.03	1.06	0.81	0.82	1.36	1.42	1.27	1.35	1.97	1.23	1.24	0.30	0.61	1.20
CVDhu	1.48	4.50	2.00	0.67	1.79	-1.34	1.03	0.00	2.44	2.39	2.12	2.61	2.00	2.63	2.26	1.94	2.54	2.53	2.18	2.22	2.60
HedPr	1.66	4.79	2.23	1.21	1.80	-1.24	1.06	2.44	0.00	1.37	1.19	1.37	1.23	1.29	0.55	0.60	1.17	1.25	0.97	1.10	1.39
BaMom	1.52	3.80	1.84	0.38	1.48	-1.01	0.81	2.39	1.37	0.00	2.37	3.31	2.87	2.86	3.30	2.77	2.93	2.96	2.54	2.68	2.57
MoB12	1.60	4.34	0.96	-0.73	1.75	-1.57	0.82	2.12	1.19	2.37	0.00	2.48	2.10	2.44	3.24	1.99	2.21	2.18	1.07	1.20	1.85
Basis	1.82	5.71	2.76	1.67	1.93	-1.54	1.36	2.61	1.37	3.31	2.48	0.00	0.50	0.53	1.02	0.29	0.57	0.58	1.34	1.18	0.33
Volat	0.93	4.88	2.33	1.07	1.52	-1.42	1.42	2.00	1.23	2.87	2.10	0.50	0.00	2.37	2.72	1.65	2.37	2.33	2.15	2.30	2.38
Value	1.89	5.22	2.87	1.76	2.01	-1.43	1.27	2.63	1.29	2.86	2.44	0.53	2.37	0.00	-0.02	0.51	0.16	0.17	1.07	0.76	-0.15
Inven	2.27	4.19	2.73	2.53	1.44	-0.55	1.35	2.26	0.55	3.30	3.24	1.02	2.72	-0.02	0.00	-2.87	-2.57	-2.65	-2.78	-2.77	-2.89
Skewn	1.31	3.75	2.46	1.01	1.22	-0.81	1.97	1.94	0.60	2.77	1.99	0.29	1.65	0.51	-2.87	0.00	3.91	4.02	4.24	4.39	4.34
OpeIn	1.95	4.87	2.57	1.40	1.89	-1.53	1.23	2.54	1.17	2.93	2.21	0.57	2.37	0.16	-2.57	3.91	0.00	-0.38	-0.86	-0.73	-0.39
Liqui	1.83	4.96	2.50	1.40	1.93	-1.45	1.24	2.53	1.25	2.96	2.18	0.58	2.33	0.17	-2.65	4.02	-0.38	0.00	-0.58	-0.33	-0.02
Mom03	1.74	4.26	1.09	0.47	1.70	-1.48	0.30	2.18	0.97	2.54	1.07	1.34	2.15	1.07	-2.78	4.24	-0.86	-0.58	0.00	0.85	1.95
Mom01	1.81	4.46	1.25	0.87	2.01	-1.59	0.61	2.22	1.10	2.68	1.20	1.18	2.30	0.76	-2.77	4.39	-0.73	-0.33	0.85	0.00	2.14
Rever	1.95	4.92	2.23	1.16	2.37	-1.78	1.20	2.60	1.39	2.57	1.85	0.33	2.38	-0.15	-2.89	4.34	-0.39	-0.02	1.95	2.14	0.00

Styled Fact - Robustness (Date Before Financialization of Commodity Markets)

Table 2.7: Descriptive Statistics - Returns to the Commodity Investment Strategies (Over Subsamples, Split around 1999)

This table reports the returns to the commodity investment strategies built on the characteristics described in Section 2.2.2. The construction of the excess returns takes into account the first notice day convention following Bakshi, Gao, and Rossi (2019). We build end-of-month series for commodity returns from March 1986 to August 2021. These data are collected from CRB, Datastream, and Factset. The left panel reports the statistics for the returns to the strategies over the full sample of data (03/1986 to 08/2021). While, the middle and right panels report the descriptive statistics for the strategies, respectively, over the periods before and after 1999, where the sample is split around January 1999. Average returns (*Mean*) and standard deviations (*Std*) are annualized in percentage. *SR* refers to the Sharpe ratio. We compute test statistics (*tstat*) using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level.

Full Sample					Pre-1999					Post-1999				
Factor	Mean%	Std%	SR	tstat	Factor	Mean%	Std%	SR	tstat	Factor	Mean%	Std%	SR	tstat
Carry***	14.82	18.76	0.79	4.81	Carry***	14.60	20.24	0.72	2.76	Carry***	14.95	17.90	0.83	3.82
Skewn***	13.86	20.83	0.67	4.00	Skewn*	10.60	21.53	0.49	1.80	Skewn***	15.72	20.45	0.77	3.62
BaMom***	13.13	25.29	0.52	2.84	BaMom***	18.68	23.34	0.80	3.19	BaMom	9.98	26.33	0.38	1.55
Inven**	-7.19	13.93	-0.52	-2.55	Inven	-5.60	14.52	-0.39	-1.34	Inven**	-8.90	13.30	-0.67	-2.30
CVDhu**	7.51	17.34	0.43	2.54	CVDhu***	11.82	16.36	0.72	3.02	CVDhu	5.05	17.87	0.28	1.27
Mom06**	9.14	23.97	0.38	2.48	Mom06	5.42	24.08	0.23	0.89	Mom06**	11.26	23.93	0.47	2.43
Mom01**	10.23	25.05	0.41	2.39	Mom01***	20.55	25.66	0.80	3.16	Mom01	4.36	24.58	0.18	0.83
Volat**	8.35	23.43	0.36	2.34	Volat***	17.32	26.43	0.66	2.97	Volat	3.23	21.44	0.15	0.73
MoB12**	10.24	28.67	0.36	2.16	MoB12*	14.70	29.34	0.50	1.85	MoB12	7.71	28.32	0.27	1.31
Mom03**	8.83	24.41	0.36	2.08	Mom03	11.77	24.30	0.48	1.54	Mom03	7.16	24.51	0.29	1.45
InflB*	7.07	21.80	0.32	1.85	InflB	1.41	19.01	0.07	0.27	InflB**	10.28	23.22	0.44	2.03
Averg*	4.53	12.00	0.38	1.81	Averg*	4.30	9.45	0.45	1.67	Averg	4.66	13.25	0.35	1.31
Rever*	6.07	22.32	0.27	1.68	Rever***	18.38	21.64	0.85	3.50	Rever	-0.93	22.48	-0.04	-0.20
DollB	-4.67	19.71	-0.24	-1.41	DollB	4.61	17.47	0.26	0.94	DollB**	-9.94	20.76	-0.48	-2.31
Mom12	4.83	21.37	0.23	1.38	Mom12**	9.71	20.10	0.48	2.03	Mom12	2.05	22.06	0.09	0.43
HedPr	3.83	18.17	0.21	1.26	HedPr	-2.25	19.53	-0.12	-0.39	HedPr**	7.28	17.30	0.42	2.23
CVSzy	3.78	17.55	0.22	1.18	CVSzy	-0.39	18.45	-0.02	-0.07	CVSzy	6.15	17.01	0.36	1.60
Basis	2.57	25.74	0.10	0.58	Basis	12.57	27.03	0.46	1.63	Basis	-3.12	24.87	-0.13	-0.60
OpeIn	-1.33	18.20	-0.07	-0.43	OpeIn	-3.56	20.34	-0.18	-0.61	OpeIn	-0.07	16.89	0.00	-0.02
Liqui	-0.60	15.57	-0.04	-0.20	Liqui	0.43	15.22	0.03	0.08	Liqui	-1.18	15.79	-0.07	-0.34
Value	0.59	18.14	0.03	0.18	Value	6.48	15.65	0.41	1.55	Value	-2.75	19.37	-0.14	-0.63

Equity Trading Strategies

In this section, we explore strategies in commodity futures markets that are inspired by the equity literature but have not been previously implemented in the existing commodity literature. Specifically, we adapt strategies outlined in Chen and Zimmermann (2020) for application to commodities whenever feasible. We retain the following set of strategies, for which we refer to their paper for further details on construction:

- 52 week high;
- CAPM beta;
- Downside beta;
- Idiosyncratic risk;
- Intermediate momentum
- Kurtosis;
- Lottery;
- Maximum return over month;
- Momentum-Reversal;
- Momentum and Volume
- Past trading volume;
- Price;
- Seasonality;
- Tail risk beta;

- Volume trend;
- Volume variance;

Overall, we observe a decline in the profitability of these trading strategies around financialization (see Figure Table 2.7 below). However, the dynamics of a couple of strategies tend to now move in the opposite direction to our baseline findings, i.e., they gain profitability after financialization. One of these strategies is CAPM beta, and it's well-established that the correlation between commodities and equities increased around financialization (see, for example Tang and Xiong (2012) and Boons, De Roon, and Szymanowska (2014)).

Moreover, in untabulated results, we regress the returns to these strategies on a dummy variable that takes the value one after financialization and zero before. We find that the strategies tend to experience a loss in profitability of around 20 basis points per month around financialization. Although this result is not statistically significant and quantitatively half of what we find for the baseline commodity strategies in Table 2.4, it qualitatively reinforces the evidence of a decay in excess returns in commodity trading strategies around financialization.

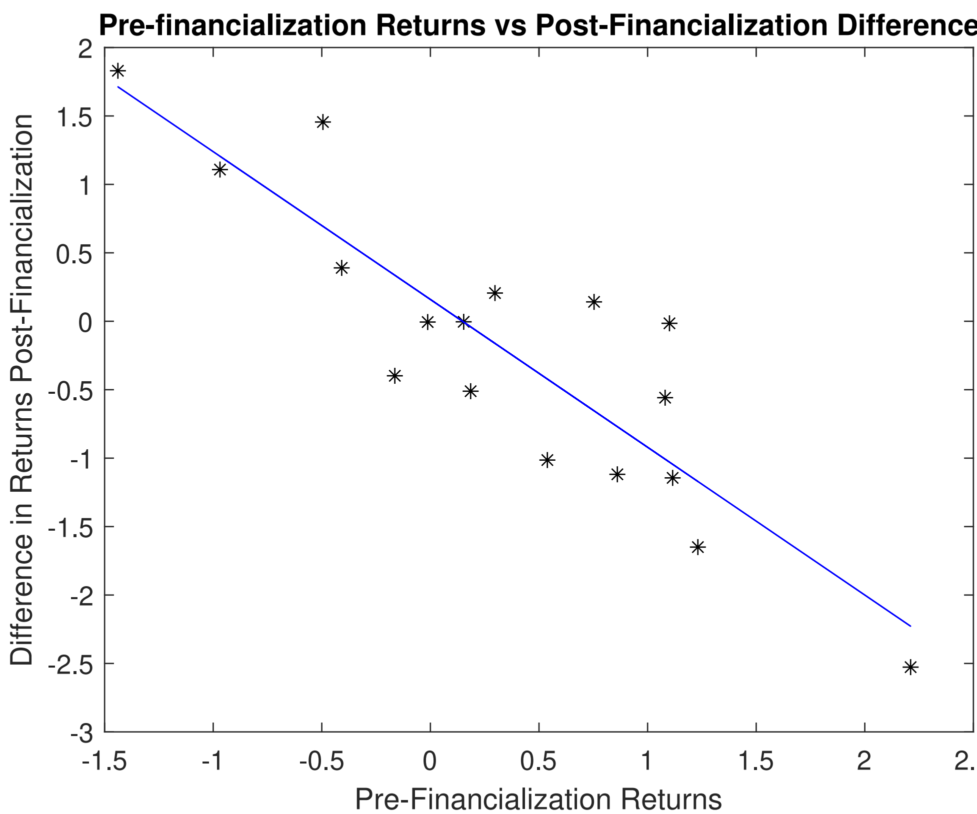

Figure 2.7: Relation between pre- and post-financializtion returns to equity strategies

This scatter plot shows the relation between the monthly returns to the 17 equity strategies (we apply to commodities) pre-financialization and the changes in their returns post-financialization. The returns pre-financialization are mean monthly excess returns in percentage points (i.e % per month). Changes in returns post-financialization are instead the difference of the mean monthly excess returns in percentage points between post-financialization and pre-financialization returns. The sample period covers monthly data from March 1986 to August 2021.

Unconditional Asset Pricing Test - 1st Stage Regressions

Table 2.8: Unconditional Asset Pricing Tests (Over Subsamples) - First Stage Regressions

This table shows the regression results from the first-stage of the Fama-MacBeth regressions in Table 2.2. Specifically, we report ordinary least squares (OLS) estimates of contemporaneous time-series regressions of the strategies on the latent risk factors (along with a constant). In the asset pricing tests, we use as test assets the returns to the commodity investment strategies presented in Table 2.1; while, the six candidate factors are the six RP-PCs extracted as in Lettau and Pelger (2020). The left panel reports the results for the test conducted over the full sample (i.e., 03/1986 to 08/2021). While, the middle and right panels report the results for the tests conducted, respectively, over the pre- and post-financialization periods, where the sample is split around January 2004. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). Alphas are expressed in percentage per month. We compute test statistics (*tstat*) using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. The data contain monthly series from March 1986 to August 2021.

	Full-Sample								Pre-Financialization								Post-Financialization							
Variable	$Cons_{\alpha}$	$PC1_{\beta}$	$PC2_{\beta}$	$PC3_{\beta}$	$PC4_{\beta}$	$PC5_{\beta}$	$PC6_{\beta}$	R2	$Cons_{\alpha}$	$PC1_{\beta}$	$PC2_{\beta}$	$PC3_{\beta}$	$PC4_{\beta}$	$PC5_{\beta}$	$PC6_{\beta}$	R2	$Cons_{\alpha}$	$PC1_{\beta}$	$PC2_{\beta}$	$PC3_{\beta}$	$PC4_{\beta}$	$PC5_{\beta}$	$PC6_{\beta}$	R2
Averg	0.01	0.08^{***}	0.19^{***}	-0.05^{**}	-0.12^{***}	-0.02	-0.13^{***}	44.46	0.12	0.05^{***}	0.13^{***}	0.00	-0.09^{***}	-0.03	-0.13^{***}	40.89	-0.09	0.14^{***}	0.27^{***}	-0.03	-0.13^{***}	-0.01	-0.15^{***}	52.06
Carry	0.21	0.26^{***}	0.25^{***}	-0.07	0.14^{***}	0.08^{*}	0.11^{**}	52.35	0.23	0.27^{***}	0.36^{***}	-0.13^{**}	0.16^{***}	0.03	0.11^{**}	64.35	0.32	0.22^{***}	0.09^{*}	-0.11^{*}	0.10^{*}	0.14^{***}	0.10^{**}	44.72
Mom06	0.08	0.36^{***}	-0.17^{***}	0.05^{**}	-0.12^{***}	-0.11^{***}	0.02	70.89	-0.12	0.37^{***}	-0.19^{***}	0.04	-0.13^{***}	-0.11^{***}	0.05	76.43	0.27	0.36^{***}	-0.11^{***}	0.10^{**}	-0.11^{***}	-0.11^{**}	-0.01	64.26
Mom12	-0.07	0.30^{***}	-0.08^{***}	-0.02	0.13^{***}	-0.36^{***}	-0.18^{***}	83.58	-0.04	0.29^{***}	-0.10^{***}	0.05	0.15^{***}	-0.34^{***}	-0.18^{***}	86.24	-0.09	0.28^{***}	-0.10^{***}	-0.10^{***}	0.13^{***}	-0.39^{***}	-0.16^{***}	81.96
InflB	0.07	0.13^{***}	0.30^{***}	-0.34^{***}	-0.16^{***}	0.02	-0.14^{***}	53.31	-0.11	0.13^{***}	0.27^{***}	-0.26^{***}	-0.09	-0.01	-0.04	32.32	0.36	0.14^{***}	0.28^{***}	-0.40^{***}	-0.22^{***}	0.09^{**}	-0.26^{***}	73.83
DollB	-0.02	-0.06^{**}	-0.23^{***}	0.32^{***}	0.08	-0.21^{***}	-0.02	43.99	-0.21	-0.03	-0.11^{**}	0.27^{***}	0.06	-0.24^{***}	0.00	30.08	0.28	-0.11^{***}	-0.40^{***}	0.26^{***}	0.07	-0.16^{***}	-0.06	62.41
CVSzy	0.24	0.10^{***}	-0.18^{***}	-0.05	-0.11^{***}	0.19^{***}	0.01	33.07	0.54	0.11^{***}	-0.25^{***}	-0.05	-0.10^{*}	0.13^{***}	0.01	39.63	0.01	0.10^{***}	-0.09^{**}	-0.01	-0.13^{***}	0.24^{***}	0.03	28.83
CVDhu	0.12	0.14^{***}	0.12^{***}	0.04	-0.10^{***}	-0.14^{***}	0.04	24.07	0.54^{*}	0.15^{***}	0.12^{***}	-0.02	-0.15^{***}	-0.15^{***}	0.01	34.90	-0.37	0.12^{***}	0.16^{***}	0.10^{*}	-0.06^{*}	-0.15^{***}	0.11	16.96
HedPr	-0.05	0.08^{***}	0.08^{*}	-0.06	-0.12^{**}	-0.11^{***}	0.38^{***}	34.22	-0.10	0.05^{**}	0.00	0.04	-0.10^{*}	-0.07	0.41^{***}	31.62	0.00	0.13^{***}	0.13^{**}	-0.11	-0.09	-0.15^{***}	0.34^{***}	44.68
BaMom	-0.06	0.30^{***}	0.19^{***}	-0.05^{*}	0.63^{***}	0.40^{***}	-0.06^{**}	87.07	0.10	0.29^{***}	0.16^{***}	-0.03	0.62^{***}	0.40^{***}	-0.06^{*}	86.71	-0.24	0.32^{***}	0.24^{***}	-0.06^{*}	0.65^{***}	0.39^{***}	-0.05^{*}	88.10
MoB12	0.14	0.44^{***}	-0.21^{***}	0.09^{***}	0.14^{***}	-0.32^{***}	-0.21^{***}	88.84	0.10	0.43^{***}	-0.24^{***}	0.10^{***}	0.16^{***}	-0.32^{***}	-0.27^{***}	92.53	0.10	0.47^{***}	-0.16^{***}	0.12^{***}	0.13^{***}	-0.33^{***}	-0.16^{***}	84.05
Basis	0.19	-0.20^{***}	0.27^{***}	0.50^{***}	-0.23^{***}	0.03	-0.16^{***}	73.65	0.31	-0.23^{***}	0.24^{***}	0.53^{***}	-0.21^{***}	-0.01	-0.18^{***}	77.15	0.09	-0.17^{***}	0.29^{***}	0.50^{***}	-0.26^{***}	0.08^{**}	-0.15^{**}	69.54
Volat	-0.15	0.17^{***}	0.42^{***}	0.15^{***}	-0.26^{***}	-0.20^{***}	-0.38^{***}	67.83	-0.04	0.18^{***}	0.41^{***}	0.17^{***}	-0.28^{***}	-0.16^{***}	-0.36^{***}	73.09	-0.31	0.15^{***}	0.42^{***}	0.14^{*}	-0.24^{***}	-0.25^{***}	-0.36^{***}	60.82
Value	0.08	-0.15^{***}	0.12^{***}	0.22^{***}	0.11^{***}	0.24^{***}	-0.02	53.24	-0.03	-0.14^{***}	0.07^{**}	0.28^{***}	0.13^{***}	0.35^{***}	-0.07	65.05	0.06	-0.19^{***}	0.15^{**}	0.17^{*}	0.12^{***}	0.13^{***}	0.07	50.24
Skewn	-0.13	0.17^{***}	0.53^{***}	0.07^{**}	-0.01	-0.10^{***}	0.42^{***}	70.16	-0.46^{*}	0.20^{***}	0.60^{***}	-0.02	-0.06	-0.10^{***}	0.38^{***}	74.32	0.15	0.14^{***}	0.49^{***}	0.11^{**}	0.02	-0.12^{***}	0.47^{***}	69.74
OpeIn	-0.05	0.03^{**}	-0.01	-0.12^{***}	-0.15^{***}	0.27^{***}	-0.47^{***}	60.85	-0.30	0.05^{**}	0.07	-0.18^{***}	-0.20^{***}	0.29^{***}	-0.52^{***}	63.43	0.21	0.00	-0.09^{***}	-0.11^{***}	-0.12^{***}	0.25^{***}	-0.42^{***}	63.71
Liqui	-0.05	0.03^{***}	0.02	-0.18^{***}	-0.11^{***}	0.24^{***}	-0.29^{***}	52.34	-0.14	0.04^{***}	0.06^{**}	-0.21^{***}	-0.14^{***}	0.23^{***}	-0.29^{***}	54.92	0.06	0.03	0.00	-0.16^{***}	-0.09^{***}	0.26^{***}	-0.31^{***}	50.96
Mom03	-0.14	0.37^{***}	-0.17^{***}	0.06^{*}	-0.30^{***}	0.24^{***}	0.11^{***}	81.49	-0.11	0.37^{***}	-0.11^{***}	0.03	-0.30^{***}	0.29^{***}	0.09^{**}	83.74	-0.13	0.37^{***}	-0.21^{***}	0.07^{**}	-0.31^{***}	0.18^{***}	0.12^{***}	80.59
Mom01	-0.05	0.31^{***}	-0.16^{***}	0.23^{***}	-0.35^{***}	0.39^{***}	0.24^{***}	79.55	-0.01	0.30^{***}	-0.18^{***}	0.28^{***}	-0.35^{***}	0.38^{***}	0.24^{***}	79.17	-0.10	0.30^{***}	-0.19^{***}	0.16^{***}	-0.35^{***}	0.41^{***}	0.24^{***}	80.82
Rever	-0.12	0.11^{***}	0.04	0.57^{***}	0.25^{***}	0.14^{***}	-0.10^{**}	67.83	-0.27	0.11^{***}	0.02	0.59^{***}	0.26^{***}	0.13^{***}	0.12	68.50	0.00	0.14^{***}	0.07^{*}	0.60^{***}	0.24^{***}	0.17^{***}	-0.22^{***}	70.09

Total Open Interest in Commodity Markets

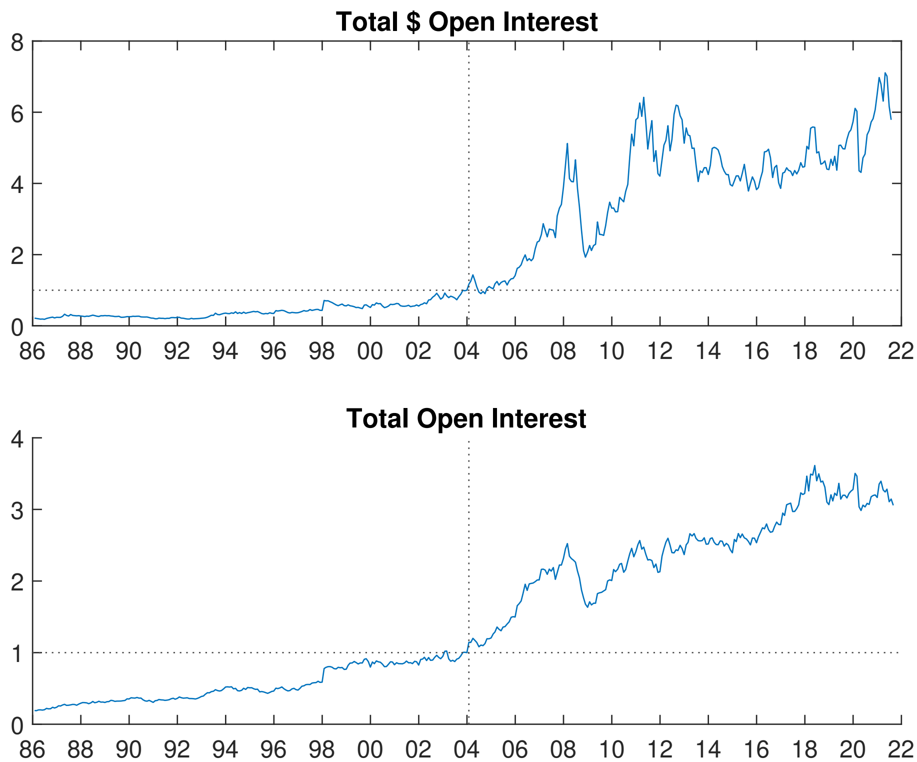

Figure 2.8: Total ($) Open Interest

This figure plots the sum of dollar open interest and open interest over time for the commodities in our sample. The data cover the period March 1986 to August 2021 and are retrieved from the CFTC. Both series are normalized to equal one in December 2003, i.e., at the outset of the financialization.

Unconditional Asset Pricing Test - Higher Number Of Latent Factors

Table 2.9: Unconditional Asset Pricing Tests (Over Subsamples) - 8 Latent-Factor Model

This table presents the results for the second (cross-sectional) stage of the Fama and MacBeth (1973) asset pricing tests, employing a higher number of latent factors compared to Table 2.2. We use as test assets the returns to the commodity investment strategies presented in Table 2.1; while, the eight candidate factors are the first eight RP-PCs extracted as in Lettau and Pelger (2020). *Panel A* reports the results for the test conducted over the full sample (i.e.,03/1986 to 08/2021); while, *Panel B* and *Panel C* report the results for the tests conducted, respectively, over the pre- and post-financialization periods, where the sample is split around January 2004. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). Mean (*Mean*) and prices of risk (*RP*) for each latent factor (the RP-PCs), as well as for the estimated intercepts, are reported in annualized percentage points. We compute test statistics (*tstat*) using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). Cross-sectional R^2 are in percentage points. The risk premium parameter of the Lettau and Pelger (2020) procedure is set equal to 10. The sample is monthly from March 1986 to August 2021.

Panel A					Full Sample				
Factors	Intercept	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Mean (%)		30.77	15.71	5.76	0.39	4.26	4.37	0.68	0.39
RP (%)	0.76	28.18	14.22	4.50	0.88	3.53	4.74	0.28	0.50
tstat_{nw}	[0.73]	[3.43]	[3.27]	[0.81]	[0.20]	[0.85]	[1.07]	[0.07]	[0.17]
tstat_{sh}	[0.74]	[3.21]	[2.76]	[0.88]	[0.19]	[0.84]	[1.18]	[0.08]	[0.15]
R2 (%)		34.08	79.20	84.95	84.92	88.04	91.25	91.30	91.32

Panel B					Pre-Financialization				
Factors	Intercept	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Mean (%)		46.09	15.67	14.51	0.99	2.25	-5.55	-4.38	0.96
RP (%)	0.59	43.63	13.33	13.39	1.71	0.72	-5.97	-3.62	0.42
tstat_{nw}	[0.55]	[3.55]	[2.70]	[1.68]	[0.38]	[0.10]	[-1.08]	[-0.65]	[0.09]
tstat_{sh}	[0.40]	[3.21]	[1.79]	[1.83]	[0.27]	[0.12]	[-1.02]	[-0.73]	[0.09]
R2 (%)		39.43	58.75	79.43	79.58	79.68	83.82	85.02	85.03

Panel C					Post-Financialization				
Factors	Intercept	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Mean (%)		15.88	15.30	-3.29	-0.42	5.96	14.26	6.14	-0.28
RP (%)	1.00	12.72	13.34	-4.88	-0.02	5.53	14.29	6.19	-0.84
tstat_{nw}	[0.76]	[1.59]	[1.96]	[-0.76]	[0.00]	[1.16]	[2.55]	[1.07]	[-0.22]
tstat_{sh}	[0.76]	[1.18]	[1.89]	[-0.70]	[0.00]	[0.94]	[2.61]	[1.16]	[-0.19]
R2		6.79	41.85	43.87	43.87	49.51	80.75	88.34	88.53

Characterising the latent factors

We here characterize the properties of the latent factor model presented in Section 2.4 which, as shown, thorugh a handful of systematic factors is able to account for the dynamics of the returns to the commodity strategies. As PCs 1, 3 and 6 are the ones that experience a significant change around the financialization and, together with PC 2, explain most of the variation across the different subsamples, we will mainly focus our analysis on the properties of these latent factors.

Factor interpretations

We start by analysing how the individual latent factors are formed from the individual commodity strategies. To this aim, we run a factor-strategy regression exercise to relate the strategy to the factors. The results are presented in Table 2.10.

The results suggest that the first factor is mostly informed by returns to momentum based strategies. The univariate regressions involving the momentum based strategies have an R-squared of at least 50% and high estimated coefficients. The evidence is not as clear-cut on the second factor; although the momentum strategies still appear to play a role in addition to the volatility strategies. PC3 is instead mainly a reversal factor, but also inflation and dollar-index strategies play a significant role in driving variations in this PC. PC4 is quite neatly identifiable as a basis-momentum factor; and PC5 appears to load primarily on momentum factors, and secondarily on open interest and liquidity. Eventually, the sixth factor is mostly informed by liquidity, open interest, volatility, and hedging pressure. This factor can therefore be labeled as a possible market friction factor.

Table 2.10: Latent Factors and Their Relations to the Commodity Investment Strategies

This table shows the regression results based on univariate regressions of each latent factor (i.e., the RP-PCs extracted as in Lettau and Pelger (2020)) on a constant and the returns to a commodity investment strategy (i.e. $RPPC_t^j = \psi_0 + \psi_1 r_t^{strategy-i} + u_t$). In the table, *Cons* refers to ψ_0, while *Slope* to ψ_1. The column *R2* reports the R^2 in percentage. While, the column *Corr* reports the correlation coefficient between the strategy and the RP-PC. We compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We build end-of-month series for commodity returns from March 1986 to August 2021. We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. The construction of the strategies is described in the separate Appendix (2.8).

	PC1				PC2				PC3				PC4				PC5				PC6			
Variables	Cons	Slope	R2	Corr	Cons	Slope	R2	Corr	Cons	Slope	R2	Corr	Cons	Slope	R2	Corr	Cons	Slope	R2	Corr	Cons	Slope	R2	Corr
Averg	0.02***	0.87***	4.52	0.21	0.01***	1.03***	17.41	0.42	0.01	-0.46**	3.62	-0.19	0.00	-0.58***	6.88	-0.26	0.00	-0.22	1.12	-0.11	0.01*	-0.62***	10.19	-0.32
Carry	0.01	1.41***	29.32	0.54	0.01**	0.27	2.86	0.17	0.01**	-0.36	5.33	-0.23	0.00	0.27***	3.74	0.19	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.03
Mom06	0.01***	1.62***	63.11	0.79	0.02***	-0.53***	18.53	-0.43	0.00	0.00	0.00	0.00	0.00	-0.16**	2.02	-0.14	0.00	-0.17**	2.79	-0.17	0.00	-0.04	0.13	-0.04
Mom12	0.02***	1.79***	60.82	0.78	0.01***	-0.36***	6.77	-0.26	0.01	-0.10	0.49	-0.07	0.00	0.20*	2.57	0.16	0.01*	-0.55***	22.42	-0.47	0.00	-0.27***	6.07	-0.25
InflB	0.02***	0.52***	5.36	0.23	0.01***	0.51***	14.16	0.38	0.01***	-0.70***	27.34	-0.52	0.00	-0.25**	4.10	-0.20	0.00	-0.02	0.03	-0.02	0.00	-0.22**	4.11	-0.20
DollB	0.03***	-0.14	0.32	-0.06	0.01***	-0.48***	10.40	-0.32	0.01**	0.78***	27.55	0.52	0.00	0.14	1.13	0.11	0.00	-0.30***	5.61	-0.24	0.00	0.02	0.02	0.01
CVSzy	0.02***	1.01***	13.17	0.36	0.02***	-0.67***	15.82	-0.40	0.01	-0.16	0.95	-0.10	0.00	-0.25**	2.81	-0.17	0.00	0.37***	6.94	0.26	0.00	0.01	0.00	0.01
CVDhu	0.02***	0.97***	11.80	0.34	0.01***	0.14	0.72	0.08	0.00	0.02	0.02	0.01	0.00	-0.23***	2.30	-0.15	0.01*	-0.37***	6.64	-0.26	0.00	0.00	0.00	0.00
HedPr	0.02***	0.42*	2.41	0.16	0.01***	0.06	0.12	0.03	0.01	-0.24**	2.19	-0.15	0.00	-0.25***	3.02	-0.17	0.00	-0.27***	3.86	-0.20	0.00	0.60***	21.50	0.46
BaMom	0.02***	0.95***	23.89	0.49	0.01***	0.02	0.03	0.02	0.01	-0.19**	2.61	-0.16	-0.01***	0.69***	43.15	0.66	0.00	0.31***	9.78	0.31	0.01	-0.14	2.20	-0.15
MoB12	0.01***	1.46***	73.03	0.85	0.02***	-0.43***	17.33	-0.42	0.00	0.04	0.18	0.04	0.00	0.12	1.66	0.13	0.01*	-0.29***	11.01	-0.33	0.01*	-0.19**	5.41	-0.23
Basis	0.03***	-1.01***	27.98	-0.53	0.01***	0.44***	14.77	0.38	0.00	0.67***	34.48	0.59	0.00	-0.25***	5.86	-0.24	0.00	0.03	0.08	0.03	0.00	-0.14*	2.22	-0.15
Volat	0.02***	0.51**	5.98	0.24	0.01***	0.57***	20.12	0.45	0.00	0.15	1.47	0.12	0.00	-0.35***	9.32	-0.31	0.01*	-0.31***	8.45	-0.29	0.01**	-0.46***	21.32	-0.46
Value	0.03***	-1.43***	28.00	-0.53	0.01***	0.42***	6.80	0.26	0.00	0.59***	13.62	0.37	0.00	0.24**	2.61	0.16	0.00	0.47***	11.76	0.34	0.00	-0.04	0.08	-0.03
Skewn	0.02***	0.30	1.65	0.13	0.00	0.83***	34.12	0.58	0.01	-0.06	0.16	-0.04	0.00	-0.03	0.05	-0.02	0.01*	-0.29***	5.98	-0.24	0.00	0.41***	13.13	0.36
OpeIn	0.03***	0.41	2.28	0.15	0.01***	-0.01	0.01	-0.01	0.00	-0.30***	3.49	-0.19	0.00	-0.32***	4.84	-0.22	0.00	0.53***	15.04	0.39	0.00	-0.79***	37.39	-0.61
Liqui	0.03***	0.41	1.74	0.13	0.01***	0.10	0.30	0.05	0.00	-0.65***	12.10	-0.35	0.00	-0.32**	3.59	-0.19	0.00	0.63***	15.93	0.40	0.00	-0.68***	20.69	-0.45
Mom03	0.01***	1.53***	58.28	0.76	0.02***	-0.56***	21.38	-0.46	0.00	-0.01	0.00	0.00	0.00	-0.36***	11.11	-0.33	0.00	0.18*	3.12	0.18	0.00	0.03	0.09	0.03
Mom01	0.02***	1.12***	32.90	0.57	0.02***	-0.53***	20.52	-0.45	0.00	0.23***	3.91	0.20	0.00	-0.41***	14.57	-0.38	0.00	0.33***	10.96	0.33	0.00	0.14	2.39	0.15
Rever	0.02***	0.29*	1.76	0.13	0.01***	-0.14	1.09	-0.10	0.00	0.93***	50.60	0.71	0.00	0.35***	8.40	0.29	0.00	0.12	1.18	0.11	0.00	-0.17**	2.69	-0.16

What are the macro-financial drivers of the latent factors?

We have established that the six-factor latent factor model spans the space of commodity futures strategy returns. To further shed light on the potential macro-drivers of the latent factors, we run univariate regressions of the individual factors, i.e. the RP-PCs, on a set of macro-financial variables:

$$RPPC_t^j = \phi_0 + \phi_1 \Delta MacroFin_t^i + \epsilon_t \tag{2.6}$$

where, $RPPC_t^j$ is the time t return of latent factor j from Table 2.2 extracted as in Lettau and Pelger (2020)), and $\Delta MacroFin$ are the innovations to the macro-financial factors. Test statistics are computed with Newey and West (1987)-corrected standard errors.

The set of macro-financial variables we consider belongs to those variables that are gaining attention in the asset pricing literature that tries to understand the link between the macroeconomy and the (global) financial conditions on the one hand, and the asset returns on the other[20]. We present the results from this exercise in Table 2.12.

We find shocks to: i) global equity volatility, ii) commodity volatility and iii) inflation to be important sources of variations for the latent factors. Specifically, global equity volatility significantly drives variations in PC1, as well as PC3 and PC5. Similarly, Bakshi, Gao, and Rossi (2019) find that equity volatility also drives variation in the carry pricing factor they include in their commodity futures asset pricing model. However, unlike the same authors, we find evidence that a similar measure of volatility constructed from commodity returns does explain variations in some of the pricing factors, namely PCs 2, 3 and 5. Additionally, we find that shocks to inflation (CPIAUCSL and WPSFD49207) strongly matter across the commodity-latent factors[21]. In particular, they drive a lot of variation in PC3, and contribute to variations in PCs 1, 2, 4 and 5.

Besides these three main macro-financial factors, shocks to other variables are also additional

[20] Table 2.11 lists and describes more in details the variables and the sources from which they are retrieved.

[21] In this respect, it is worth pointing out that the role of inflation risk in driving asset prices is drawing a remarkable attention in the current academic debate (see Fang, Liu, and Roussanov (2022), among others).

sources of variation that (more weakly) affect the latent factors whose dynamics change around the financialization. Specifically, variations in PC1 are driven also by shocks to the forex factors (TWEXAFE and sliq). While, variations in PC2 partly come from financial variables that can loosely be linked to variations in discount rates.

PC3 is instead negatively related to positive shocks in the S&P 500 (as also PC5) and the global financial cycle, and positively related to the default spread. Taken together, this suggests that PC3 is partly related to investor risk aversion similar to what Bakshi, Gao, and Rossi (2019) find for their carry factor.

Lastly, PC6 only loads on industrial production and the forex factor, but with an opposite sign in the loadings with respect to PC1.

Overall, although previous literature finds that only a handful of macro-financial variables are relevant for the cross-section of commodity futures, we find the opposite results. For most of the macro-financial variables we study, we find that shocks to them can be traced to at least one of the latent pricing factors.

As we saw in the previous section, the average returns of the latent factors tend to change between pre- and- post-financialization. Table 2.13 and Table 2.14 repeat the univariate regressions of the macro-financial factors on the RP-PCs, respectively, over the pre- and post- financialization periods. Interestingly, it appears that variations in macro-financial risks tend to be a more relevant determinant of variation in the latent risk factors since the occurrence of the financialization.

Macro-Financial Variables - Tables

Table 2.11: Description of the Macro-Financial Variables

This table reports, in the first column (*Variables*) the names of the macro-financial variables used in in Table 2.12. The second column (*Category*) reports to which broad category the variables belong to. The third column (*Description*) provides concise descriptions of the variables along with the sources from which the data are retrieved. Eventually, the fourth (*Start*) and fifth columns (*End*) report the period for which the macro-financial variables are available. For each variable, innovations to the factor are estimated as the first difference of the factor, as the residuals from an AR(1) fitted to the factor itself, or following the FRED-MD dataset of McCracken and Ng (2016) (https://research.stlouisfed.org/econ/mccracken/fred-databases/).

Variables	Category	Description	Start	End
sliq	Financial	Systematic, low frequency, FX (il)liquidity factor. Source: Angelo Ranaldo's website.	01/1991	07/2019
icap	Financial	Intermediary capital risk factor. Source: Zhiguo He's website.	01/1986	06/2021
gfc	Financial	Global financial cycle factor. Source: http://silviamirandaagrippino.com/code-data	01/1986	04/2019
ted	Financial	TED spread. Source: https://fred.stlouisfed.org/series/TEDRATE	01/1986	06/2021
GS10	Financial	10-Year Treasury Rate. Source: https://research.stlouisfed.org/econ/mccracken/fred-databases/	01/1986	04/2021
TWEXAFE	Financial	Trade Weighted U.S. Dollar Index. Source: https://research.stlouisfed.org/econ/mccracken/fred-databases/	01/1986	04/2021
BAAMAAA	Financial	Baa Minus Aaa Corporate Bond Yield. Source: https://research.stlouisfed.org/econ/mccracken/fred-databases/	01/1986	04/2021
S&P 500	Financial	S&P 500. Source: https://research.stlouisfed.org/econ/mccracken/fred-databases/	01/1986	04/2021
equ_vol	Financial	Equity Volatility. Source: constructed as in Bakshi, Gao, and Rossi (2019).	01/1986	04/2021
comm_vol	Financial	Commodity Volatility. Source: constructed as in Bakshi, Gao, and Rossi (2019).	01/1986	04/2021
gecon	Macro	Global Economic Conditions Indicator. Source: https://sites.google.com/site/cjsbaumeister/research	02/1986	09/2021
INDPRO	Macro	IP Index. Source: https://research.stlouisfed.org/econ/mccracken/fred-databases/	01/1986	04/2021
WPSFD49207	Macro	PPI: Finished Goods. Source: https://research.stlouisfed.org/econ/mccracken/fred-databases/	01/1986	04/2021
CPIAUCSL	Macro	CPI : All Items. Source: https://research.stlouisfed.org/econ/mccracken/fred-databases/	01/1986	04/2021

Table 2.12: Latent Factors and Their Relations to Macro-Financial Variables

This table shows the regression results based on univariate regressions of each latent factor (i.e., the RP-PCs extracted as in Lettau and Pelger (2020)) on a constant and a macro-financial variable (i.e. $RPPC_t^j = \phi_0 + \phi_1 \Delta MacroFin_t^i + \epsilon_t$). In the table, *Cons* refers to ϕ_0, while *Slope* to ϕ_1. The column *R2* reports the R^2 in percentage. We build end-of-month series for commodity returns from March 1986 to August 2021. We compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. Table 2.11 in the separate Appendix reports the description of each variable.

		PC1			PC2			PC3			PC4			PC5			PC6		
Variables	Category	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2
sliq	Financial	0.03***	-0.05**	1.57%	0.01***	-0.02	0.51%	0.00	0.01	0.26%	0.00	0.01	0.40%	0.00	0.01	0.13%	0.00	0.00	0.00%
icap	Financial	0.03***	-0.14	0.47%	0.01***	0.22***	3.11%	0.00	-0.13	1.10%	0.00	0.07	0.36%	0.00	-0.06	0.33%	0.00	-0.04	0.15%
gfc	Financial	0.03***	0.05	0.61%	0.01***	0.08***	5.45%	0.00	-0.06***	3.13%	0.00	0.00	0.02%	0.00	-0.03	0.69%	0.00	-0.02	0.53%
ted	Financial	0.03***	0.03	0.20%	0.01***	-0.04***	1.09%	0.00	0.04**	1.35%	0.00	0.00	0.01%	0.00	0.04**	1.58%	0.00	-0.03	0.76%
GS10	Financial	0.03***	-0.01	0.06%	0.01***	0.05***	1.48%	0.00	-0.03	0.66%	0.00	-0.01	0.14%	0.00	0.04**	1.28%	0.00	-0.02	0.52%
TWEXAFE	Financial	0.03***	-0.91**	1.13%	0.01***	-0.39	0.58%	0.00	0.72***	1.99%	0.00	0.22	0.22%	0.00	-0.18	0.18%	0.00	0.42*	1.04%
BAAMAAA	Financial	0.03***	-0.05	0.15%	0.01***	-0.13*	2.42%	0.00	0.14***	3.13%	0.00	0.05	0.42%	0.00	0.01	0.02%	0.00	0.05	0.67%
S&P 500	Financial	0.03***	0.19	0.25%	0.01***	0.37***	2.60%	0.01	-0.29*	1.63%	0.00	0.07	0.12%	0.00	-0.29***	2.31%	0.00	-0.09	0.23%
equ_vol	Financial	0.02***	-5.66**	2.48%	0.01***	-0.94	0.19%	0.01	3.61***	2.82%	0.00	0.05	0.00%	0.00	2.35***	1.67%	0.00	0.11	0.00%
comm_vol	Financial	0.02***	0.37	0.00%	0.01***	-5.59*	1.58%	0.01	9.20**	4.43%	0.00	-1.10	0.08%	0.00	4.29*	1.36%	0.00	2.12	0.36%
gecon	Macro	0.03***	0.00	0.00%	0.01***	0.06***	6.51%	0.00	-0.04**	2.23%	0.00	-0.01	0.22%	0.00	-0.03***	2.24%	0.00	-0.02	1.05%
INDPRO	Macro	0.03***	0.02	0.00%	0.01***	1.00	0.77%	0.00	-0.04	0.00%	0.00	-0.32	0.10%	0.00	-1.17***	1.52%	0.01	-0.97**	1.15%
WPSFD49207	Macro	0.03***	1.28	0.46%	0.01***	1.89*	2.81%	0.00	-2.12***	3.62%	0.00	-0.81	0.64%	0.00	-0.69	0.54%	0.00	-0.60	0.45%
CPIAUCSL	Macro	0.03***	4.84*	0.85%	0.01***	4.79**	2.31%	0.00	-6.74***	4.67%	0.00	-4.08***	2.08%	0.00	-2.70**	1.05%	0.00	-2.08	0.69%

Table 2.13: Latent Factors and Their Relations to Macro-Financial Variables (Pre-Financialization)

This table shows the regression results based on univariate regressions of each latent factor (i.e., the RP-PCs extracted as in Lettau and Pelger (2020)) on a constant and a macro-financial variable (i.e. $RPPC_t^j = \phi_0 + \phi_1 \Delta MacroFin_t^i + \epsilon_t$). In the table, *Cons* refers to ϕ_0, while *Slope* to ϕ_1. The column *R2* reports the R^2 in percentage. We build end-of-month series for commodity returns from March 1986 to August 2021. The sample is split around January 2004. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). We compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. Table 2.11 in the separate Appendix reports the description of each variable. Results for the subset of variables that are found to be not significant are not reported, but are available upon request.

		PC1			PC2			PC3			PC4			PC5			PC6		
Variables	Category	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2
sliq	Financial	0.040***	-0.027	0.48%	0.013***	0.027**	2.45%	0.008	-0.007	0.13%	0.000	0.015	0.62%	-0.001	-0.004	0.06%	-0.003	-0.025**	2.74%
icap	Financial	0.040***	-0.242	1.09%	0.013**	0.043	0.11%	0.012**	0.072	0.33%	0.000	0.158**	2.04%	0.003	-0.125*	1.36%	-0.005	0.055	0.29%
gfc	Financial	0.039***	-0.087	1.09%	0.013**	0.060**	1.66%	0.012**	-0.028	0.37%	0.001	0.037	0.89%	0.002	-0.038	0.99%	-0.005	-0.015	0.16%
ted	Financial	0.038***	0.012	0.03%	0.013**	0.003	0.01%	0.012**	0.008	0.04%	0.001	-0.033	0.91%	0.002	0.054**	2.61%	-0.005	-0.056**	3.06%
GS10	Financial	0.038***	-0.039	0.39%	0.014**	0.041**	1.37%	0.012**	0.005	0.02%	0.000	-0.026	0.77%	0.003	0.040**	1.90%	-0.005	-0.010	0.12%
S&P 500	Financial	0.042***	-0.467	1.13%	0.011**	0.236*	0.94%	0.011*	0.150	0.39%	-0.001	0.259*	1.54%	0.004	-0.350**	2.98%	-0.005	0.022	0.01%
equ_vol	Financial	0.038***	-7.388**	2.10%	0.013**	1.698	0.36%	0.012**	3.653**	1.72%	0.001	-1.737	0.51%	0.002	2.913**	1.54%	-0.005	-1.012	0.20%
comm_vol	Financial	0.038***	5.405	0.34%	0.013**	-0.530	0.01%	0.012**	8.131	2.55%	0.001	-6.778**	2.33%	0.002	2.521	0.34%	-0.005	-0.595	0.02%
gecon	Macro	0.040***	-0.021	0.19%	0.010*	0.035**	1.64%	0.012*	0.005	0.03%	0.001	-0.001	0.00%	0.005	-0.040**	3.14%	-0.006	0.017	0.58%
WPSFD49207	Macro	0.038***	2.918	0.98%	0.013**	1.167	0.51%	0.012**	-2.363**	2.16%	0.001	1.157	0.68%	0.002	0.112	0.01%	-0.005	-1.740**	1.79%
CPIAUCSL	Macro	0.038***	2.663	0.13%	0.013**	-0.449	0.01%	0.012**	-3.796*	0.90%	0.001	-1.342	0.15%	0.002	-0.167	0.00%	-0.005	0.180	0.00%

Table 2.14: Latent Factors and Their Relations to Macro-Financial Variables (Post-Financialization)

This table shows the regression results based on univariate regressions of each latent factor (i.e., the RP-PCs extracted as in Lettau and Pelger (2020)) on a constant and a macro-financial variable (i.e. $RPPC_t^j = \phi_0 + \phi_1 \Delta MacroFin_t^i + \epsilon_t$). In the table, *Cons* refers to ϕ_0, while *Slope* to ϕ_1. The column *R2* reports the R^2 in percentage. We build end-of-month series for commodity returns from March 1986 to August 2021. The sample is split around January 2004. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). We compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level. Table 2.11 in the separate Appendix reports the description of each variable. Results for the subset of variables that are found to be not significant are not reported, but are available upon request.

		PC1			PC2			PC3			PC4			PC5			PC6		
Variables	Category	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2	Cons	Slope	R2
sliq	Financial	0.015**	-0.062**	3.20%	0.012**	-0.060***	6.88%	-0.005	0.035**	2.05%	0.006	0.018	0.60%	0.006	0.021	1.08%	0.009*	0.015	0.56%
icap	Financial	0.014*	-0.054	0.09%	0.014***	0.405***	10.96%	-0.003	-0.351***	8.49%	0.001	-0.027	0.05%	0.004	0.006	0.00%	0.012**	-0.127	1.77%
gfc	Financial	0.018**	0.117***	8.03%	0.012***	0.098***	12.66%	-0.006	-0.084***	8.75%	0.005	-0.031	1.24%	0.006	-0.018	0.50%	0.009*	-0.022	0.85%
ted	Financial	0.014*	0.018	0.13%	0.014***	-0.050**	2.22%	-0.004	0.060*	3.21%	0.001	0.024	0.55%	0.004	0.020	0.47%	0.012**	-0.010	0.13%
GS10	Financial	0.015*	0.025	0.17%	0.015***	0.053**	1.69%	-0.005	-0.085**	4.43%	0.001	0.010	0.06%	0.004	0.028	0.66%	0.012**	-0.041	1.61%
TWEXAFE	Financial	0.015**	-1.423***	3.46%	0.014***	-1.113***	4.61%	-0.004	1.641***	10.32%	0.001	0.754*	2.39%	0.003	-0.027	0.00%	0.012*	0.232	0.33%
BAAMAAA	Financial	0.015*	-0.064	0.48%	0.014***	-0.183***	8.72%	-0.004	0.159***	6.77%	0.001	0.054	0.84%	0.003	0.008	0.03%	0.013***	0.074	2.36%
S&P 500	Financial	0.010	0.792**	6.05%	0.011**	0.498***	5.20%	0.000	-0.704***	10.73%	0.002	-0.101	0.24%	0.005	-0.240*	1.71%	0.014**	-0.183	1.15%
equ_vol	Financial	0.011	-4.858*	3.58%	0.014***	-2.176**	1.45%	-0.002	3.601*	4.18%	0.002	0.895	0.28%	0.003	2.090**	1.95%	0.012**	0.640	0.21%
comm_vol	Financial	0.011	-3.107	0.32%	0.013***	-8.753**	5.05%	-0.002	9.928**	6.87%	0.002	2.660	0.54%	0.003	5.537***	2.96%	0.012***	3.938	1.70%
gecon	Macro	0.015**	0.024	1.28%	0.015***	0.031***	4.69%	-0.004	-0.030**	4.51%	0.000	0.009	0.48%	0.005	-0.006	0.24%	0.010**	-0.028***	6.28%
INDPRO	Macro	0.015*	-0.310	0.06%	0.013**	1.129	1.62%	-0.003	-0.573	0.43%	0.001	-0.252	0.09%	0.005	-1.259***	2.87%	0.013***	-0.920	1.78%
WPSFD49207	Macro	0.015*	0.662	0.25%	0.014**	2.163*	5.89%	-0.004	-2.037***	5.38%	0.001	-1.472**	3.08%	0.003	-0.944	1.60%	0.012**	-0.189	0.07%
CPIAUCSL	Macro	0.015*	5.699**	2.20%	0.014***	7.335***	7.91%	-0.004	-8.110***	9.96%	0.001	-5.324***	4.71%	0.003	-3.826***	3.06%	0.012	-3.086*	2.30%

Table 2.15: Descriptive Statistics - Returns to the Commodity Investment Strategies (Over Subsamples, Excluding GFC and Covid)

This table reports the returns to the commodity investment strategies built on the characteristics described in Section 2.2.2. The construction of the excess returns takes into account the first notice day convention following Bakshi, Gao, and Rossi (2019). We build end-of-month series for commodity returns from March 1986 to August 2021. These data are collected from CRB, Datastream, and Factset. The left panel reports the statistics for the returns to the strategies over the full sample of data (03/1986 to 08/2021). While, the middle and right panels report the descriptive statistics for the strategies, respectively, over the pre- and post-financialization periods, where the sample is split around January 2004. However, it's important to note that in this table, the analysis conducted over the full sample and post-financialization period (i.e., the first and third panels) excludes the Global Financial Crisis and Covid periods. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Boons, De Roon, and Szymanowska (2014) and Basak and Pavlova (2016), among others). The data for the sorting variables are retrieved from different sources, as reported in the separate Appendix 2.8 which also describes how the strategies are constructed. *Inventory* is available only up to beginning of 2011. Average returns (*Mean*) and standard deviations (*Std*) are annualized in percentage. *SR* refers to the Sharpe ratio. We compute test statistics (*tstat*) using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)). We denote with ***, **, * estimates significant at the, respectively, 1%, 5% and 10% level.

Full Sample					Pre-Financialization					Post-Financialization				
Factor	Mean%	Std%	SR	tstat	Factor	Mean%	Std%	SR	tstat	Factor	Mean%	Std%	SR	tstat
Carry***	14.89	18.71	0.80	4.69	Carry***	18.49	20.64	0.90	3.95	Carry**	10.17	15.78	0.64	2.40
BaMom***	17.18	23.99	0.72	4.33	BaMom***	18.77	25.77	0.73	3.17	BaMom***	15.09	21.48	0.70	2.88
Skewn***	12.62	20.65	0.61	3.47	Skewn*	10.63	22.89	0.46	1.89	Skewn***	15.24	17.31	0.88	3.57
CVDhu***	9.25	17.01	0.54	3.14	CVDhu***	14.56	17.69	0.82	3.76	CVDhu	2.29	15.89	0.14	0.56
Volat***	11.09	23.12	0.48	3.13	Volat***	18.33	25.03	0.73	3.89	Volat	1.54	20.08	0.08	0.30
MoB12**	11.43	28.38	0.40	2.30	MoB12***	18.85	31.26	0.60	2.63	MoB12	1.69	23.89	0.07	0.28
Inven**	-7.28	14.27	-0.51	-2.30	Inven**	-8.30	14.26	-0.58	-2.36	Inven	-2.73	14.37	-0.19	-0.38
Averg**	4.56	10.31	0.44	2.24	Averg***	5.77	9.47	0.61	2.58	Averg	2.97	11.32	0.26	0.91
Mom06*	7.66	24.11	0.32	1.95	Mom06**	11.98	25.93	0.46	2.05	Mom06	1.98	21.45	0.09	0.45
Mom12*	6.72	21.23	0.32	1.88	Mom12**	12.22	22.92	0.53	2.40	Mom12	-0.49	18.65	-0.03	-0.11
Mom03*	8.31	24.29	0.34	1.80	Mom03**	13.84	25.27	0.55	2.25	Mom03	1.06	22.85	0.05	0.17
Mom01*	8.26	24.42	0.34	1.77	Mom01**	14.28	26.28	0.54	2.34	Mom01	0.36	21.60	0.02	0.06
Rever	6.43	22.28	0.29	1.63	Rever**	11.58	23.02	0.50	2.25	Rever	-0.33	21.19	-0.02	-0.05
InflB	6.09	20.97	0.29	1.61	InflB	5.10	19.98	0.26	1.09	InflB	7.38	22.26	0.33	1.27
CVSzy	3.43	17.57	0.20	1.06	CVSzy	5.23	19.33	0.27	1.08	CVSzy	1.08	14.97	0.07	0.29
Basis	3.41	25.70	0.13	0.75	Basis	5.40	27.94	0.19	0.78	Basis	0.78	22.48	0.03	0.14
DollB	-2.54	19.06	-0.13	-0.75	DollB	-2.29	18.81	-0.12	-0.50	DollB	-2.86	19.43	-0.15	-0.58
HedPr	1.97	17.60	0.11	0.66	HedPr	-0.66	18.24	-0.04	-0.15	HedPr	5.43	16.72	0.32	1.59
Value	1.82	17.61	0.10	0.53	Value	-0.05	18.40	0.00	-0.01	Value	4.28	16.55	0.26	0.94
OpeIn	-1.71	18.68	-0.09	-0.52	OpeIn	0.19	21.03	0.01	0.04	OpeIn	-4.21	15.09	-0.28	-1.24
Liqui	-0.46	15.65	-0.03	-0.16	Liqui	-0.15	16.02	-0.01	-0.04	Liqui	-0.86	15.22	-0.06	-0.23

Chapter 3

Subjective risk premia and intermediary asset pricing: evidence from commodity markets*

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3.1 Introduction

Expectations lie at the core of asset pricing. A primary focus of research is indeed to understand the dynamics of expected excess returns over time. To achieve this goal, it is essential to study the real-time return expectations of (marginal) investors. Survey data on ex-ante subjective return expectations, as opposed to ex-post realized returns, provide valuable insights for this purpose. However, as argued also in Adam and Nagel (2023), to effectively map the dynamics of survey-based return expectations into asset pricing models, it is crucial to take a stand on whether the survey forecasters represent the marginal investors within specific models.

Therefore, I start by observing that a large portion of professional forecasters in commonly used surveys are, in fact, financial intermediaries. Consequently, intermediary-based asset pricing models (e.g., He and Krishnamurthy (2013)), which target the average expectation of intermediaries as the marginal investors in financial markets, should provide a suitable framework for matching the dynamics of the subjective return expectations. Given that the expectations of financial intermediaries may impact asset prices, macroeconomic outcomes, and credit supply, it is important to determine the factors that shape these expectations.

In this paper, I build upon these theories that attribute to financial intermediaries a key role for expected returns and I contribute to the existing literature on subjective risk premia by empirically analysing whether the subjective return expectations of professional forecasters, for a sophisticated asset class like commodities, are impacted by shocks to the average financial health of intermediaries. Given that financial intermediaries actively and frequently trade across many markets and possess expertise in complex assets, they are natural candidates to be the marginal investors in financial markets. Therefore, shocks to their financial health, serving as a proxy for their marginal value of wealth, should affect expected returns. While empirical studies in the intermediary-based literature, such as Haddad and Muir (2021), have demonstrated that these shocks explain variation in realized returns, particularly in more sophisticated asset classes, the question of whether they also drive variation in subjective return expectations remains unanswered.

The dynamics of subjective risk premia and realized returns can indeed substantially diverge, as highlighted in Nagel and Xu (2023), among others.[2] Additionally, I investigate whether the relation between intermediary financial health and subjective risk premia varies over time and with changes in relevance of different types of intermediaries participating in the market. Empirical evidence on the time-variation and the relevance of heterogeneity among intermediaries remains limited, even within the literature focusing on realized returns. Overall, my findings shed light on the role of intermediary financial health both as a potential driver of risk premia and as a relevant information on which intermediaries condition when forming their expectations.

To measure the health of financial intermediaries, I adopt a well-established proxy from the asset pricing literature. Specifically, I use the intermediary capital ratio of He, Kelly, and Manela (2017), which measures the marginal utility of wealth for primary dealers who serve as counterparties the Federal Reserve Bank of New York in its monetary policy operations. These intermediaries, such as J.P. Morgan or Goldamn Sachs, are large and sophisticated institutions that trade in all asset markets, face low transaction costs, and employ updated, high frequency, and sophisticated trading models. Therefore, they act as marginal investors in many financial markets.

I then construct subjective risk premia for commodities, relying on return expectations of professional forecasters collected by Consensus Economics.[3] Commodity markets provide an ideal setting to assess the relevance of intermediaries in driving subjective excess returns for three main reasons. First, the survey participants who provide expectations for commodity prices are primarily financial intermediaries. Second, commodity markets are a strongly sophisticated asset class where, as such, intermediaries play potentially a crucial role in driving the dynamics of risk premia. Third, there has been a fast and unprecedented increase in commodity futures market participation by financial institutions occurred around 2004, which is commonly referred to as the

[2]Other papers arguing that there is a wedge between subjective and objective risk premia include: Cieslak (2018), Xu (2020), Adam, Matveev, and Nagel (2021), Nagel and Xu (2022), Dahlquist and Söderlind (2023).

[3]Consensus Economics is a prominent international survey provider for macroeconomic and financial forecasts, including exchange rates and commodity prices. These forecasts are commonly used in the literature on subjective risk premia (see, for example, Valente, Vasudevan, and Wu (2022), Nagel and Xu (2023), and Kremens, Martin, and Varela (2023)).

"financialization" of commodity markets (e.g., Henderson, Pearson, and Wang (2015b) and Basak and Pavlova (2016)). The large entry of traders such as hedge funds, asset managements and pension funds had a significant impact on the commodity futures markets and their composition of market participants, as discussed in studies such as Büyükşahin and Robe (2014), Brunetti, Büyükşahin, and Harris (2016), and Goldstein and Yang (2021). Consequently, this change enables me to delve into a shift in investor types within the same asset class, and analyze whether and how the influence of intermediaries on subjective expected returns changes over time.

In the first part of the analysis, I conduct standard in-sample predictive regressions to demonstrate that the financial health of intermediaries predicts subjective risk premia in a portfolio of commodities. Consistent with intermediary-based theories, I find that when the risk-bearing capacity of intermediaries is impaired, and their effective risk aversion increases due to negative shocks to equity capital, (subjective) expected returns significantly rise in the subsequent period. The economic magnitude of this effect is substantial; a one-standard deviation increase in intermediary effective risk aversion is associated with a more than 0.2 increase in standardized subjective risk premia. In contrast to findings for other predictors (e.g., Nagel and Xu (2023) and others), this magnitude is at least as large as what the previous literature has observed for realized returns (see Haddad and Muir (2021)). Therefore, this result offers new evidence that the financial health of the intermediary sector is a relevant source of variation of the return expectations of professional forecasters, at least for an intermediated asset class as commodities. Subjective risk premia exhibit countercyclical variations in line with a (rational expectations) intermediary-based asset pricing framework. Additionally, this finding indicates that shocks to intermediary capital may serve as a relevant source of information on which investors rely to form their return expectations.

Next, I explore the "financialization" of commodity markets to understand whether the relationship between intermediaries and subjective return expectations changes over time. To do so, I extend the baseline predictive regression by including an interaction term between intermediary financial health and a financialization dummy variable. The previously estimated coefficient masks a more complex dynamic. Before the "financialization" intermediary financial health drives variations in subjective return expectations more strongly than what observed on average. However, the relevance of intermediaries, specifically primary dealers, diminishes after the financialization. In particular, a one-standard deviation increase in the intermediary risk aversion measure is associated with at least a 0.5 increase in the standardized subjective risk premia. In contrast, after the financialization, this effect is not significant anymore. Overall, these findings reinforce the evidence on the existence of the relationship between intermediaries and subjective risk premia, while also documenting a significant time variation in this relation.

After revealing the change in the relationship between intermediary financial health and subjective risk premia following the "financialization", I shed light on the potential economic mechanism behind the declining relevance of primary dealers in driving commodities subjective risk premia. To this aim, I investigate two main hypothesis.

First, the "financialization" was characterized by a large and fast increase in participation of institutional investors, such as hedge funds and asset managements. Hence, one hypothesis is that primary dealers began to lose their significance as marginal investors in the commodity markets, while other types of institutional investors entering the market started to gain more prominence over time. Consequently, I build upon a placebo test in He, Kelly, and Manela (2017) and construct a measure of the financial health of *non*-primary dealers, i.e. standalone broker-dealers such as Blackrock and Charles Schwab. In contrast to my results for primary dealers, I find that the financial health of non-primary dealers is not relevant for return expectations before the "financialization". However, it gains importance over time, indicating that different types of financial intermediaries impact the dynamics of return expectations differently. This result partially complements recent research, including Kargar (2021) and Ma (2023), showing that the composition of the financial sector has important asset pricing implications beyond the health of the aggregate financial sector, particularly for stocks and bonds but less so for other asset classes like commodities. Overall, my findings indicate that there is a change over time in the relevance of different intermediary types for return expectations. Hence, the heterogeneity among financial intermediaries and shifts in their market participation play a non-trivial role in shaping the dynamics of subjective risk premia in commodity markets. Moreover, the source of information that investors use to form their expectations appears to change over time, in conjunction with shifts in the composition of market participants.

Second, the rise of index investing presents an alternative mechanism that could contribute to the declining relevance of primary dealers in driving subjective risk premia following the "financialization". To investigate this possibility, I examine the predictability of the return expectations for a portfolio composed of non-index commodities. The findings indicate that the role of primary dealers' financial health in driving variation in subjective risk premia for non-index commodities does not significantly decrease after "financialization". Therefore, the decline is primarily observed in those commodities more profoundly affected by "financialization", namely, commodities that constitute major indexes. This result could suggest that the substantial influx of slow-moving capital through index investing contributes to the reduced role of primary dealers in actively shaping commodity risk premia. However, it also appears that the influx of index capital is not the primary driving force behind the observed dynamics, as the impact of intermediary financial health on return expectations in non-index commodities is not particularly significant, even before the "financialization" period.

Furthermore, as the expectations of professional forecasters encompass beliefs from various types of intermediaries, I also conduct a separate analysis to distinguish between the subjective risk premia of primary dealers and those of all other professional forecasters (commercial banks, financial advisors, etc). Subsequently, I examine how the financial health of primary dealers and non-primary dealers independently relates to the return expectations within the two distinct subgroups of professional forecasters. Overall, the findings reveal similar patterns to those observed across all forecasters for both subgroups. Specifically, while the financial health of primary dealers is a significant driver of subjective risk premia on average, its relevance diminishes in the wake of the "financialization". In contrast, the significance of the financial health of non-primary dealers appears to increase only later. Hence, the return expectations of various types of investors have similar dynamics with respect to the financial health of different intermediaries. This suggests that intermediaries' return expectations exhibit a substantial degree of homogeneity in their reliance on these shocks.

To further investigate the potential homogeneity of expectations among intermediaries, I also explore the Consensus Economics forecasts' panel dimension through panel tests of each forecaster's subjective return expectations. These tests are conducted on both the average intermediary financial health and the forecaster's own financial health. The results highlight that individual expectations of the intermediaries exhibit similar dynamics to what is observed on average, albeit with smaller economic magnitudes. This further reinforces the substantial degree of homogeneity among the different intermediaries providing the forecasts.

My results are robust to additional analysis. To address a non-discrete effect of the "financialization", I construct a continuous financialization-measure using the growth in open interest as an alternative to the baseline dummy variable. Moreover, to account for potential changes in commodity markets during the "financialization", I consider various factors that might have influenced the dynamics of excess returns around this episode. These factors include, among others, potential shifts in hedging pressure from hedgers to speculators, which are controlled for using measures constructed from CFTC data as in Szymanowska et al. (2014). Furthermore, I control for the role of extrapolation from past return expectations and realized returns in shaping the subjective return expectations (e.g., Greenwood and Shleifer (2014) and Andonov and Rauh (2022)). Overall, the relevance of intermediary financial health in driving commodity subjective risk premia, and the decrease in the significance of primary dealers after financialization, are robust to alternative specifications. However, in line with findings from previous studies, professional forecasters in commodity markets exhibit strong contrarian behavior in relation to recent past excess returns on commodity futures. Lastly, the relevance of intermediaries in driving variations in commodity subjective risk premia does not appear to be confined to a specific period of intermediaries distress, such as the global financial crisis.

Literature Review. This work contributes to three main strands of the literature. First, it adds to the growing body of research on the dynamics of survey expectations and risk premia within and across asset classes. This includes studies on stocks (Adam, Matveev, and Nagel (2021), De La O and Myers (2021), Heyerdahl-Larsen and Illeditsch (2021), Nagel and Xu (2022), Jensen (2022), Bastianello (2022), Dahlquist and Ibert (2023), and Boons, Ottonello, and Valkanov (2023)), bonds (Piazzesi, Salomao, and Schneider (2015), Cieslak (2018), Xu (2020), Giacoletti, Laursen, and Singleton (2021), and Singleton (2021)), foreign bonds (Pesch, Piatti, and Whelan (2023)), forex (Valente, Vasudevan, and Wu (2022), Dahlquist and Söderlind (2023) and Kremens, Martin, and Varela (2023)), and across asset classes, including commodities, (Bacchetta, Mertens, and Van Wincoop (2009), Andonov and Rauh (2022), and Nagel and Xu (2023)). Many of these papers examine the cyclical patterns of subjective risk premia computed from professional or individual forecasts. However, the evidence on what drives the return expectations has so far been limited and often mixed (see also Adam and Nagel (2023) for a review). My study diverges from the existing literature by recognizing that the return expectations of professional forecasters predominantly reflect the expectations of financial intermediaries. Consequently, it demonstrates that the dynamics of subjective risk premia, for an intermediated asset class as commodities, exhibit countercyclical variations with the financial health of intermediaries. This finding suggests that intermediary-based models offer a promising framework for examining the dynamics of subjective risk premia and to understand how financial intermediaries, i.e. marginal investors, form their expectations.

The second strand of the literature to which I contribute consists of studies on intermediary-based asset pricing. These papers emphasize that financial intermediaries are the marginal investors in financial markets. Therefore, in theory, intermediaries should affect asset prices and expected returns (see, for example, the models in He and Krishnamurthy (2012), He and Krishnamurthy

(2013) and Brunnermeier and Sannikov (2014)). Empirically, the dynamics of intermediary balance sheet explain cross-sectional and time series variation of realized returns in stocks and bonds (Adrian, Etula, and Muir (2014) and Haddad and Sraer (2020)), MBS (Gabaix, Krishnamurthy, and Vigneron (2007) and Diep, Eisfeldt, and Richardson (2021)), commodities (Etula (2013)), options (Chen, Joslin, and Ni (2019)), FX and emerging markets sovereign bonds (Fang and Liu (2021) and Du, Hébert, and Huber (2023)) and, more broadly, in many asset classes (He, Kelly, and Manela (2017) and Baron and Muir (2022)). More specifically, Haddad and Muir (2021) employ an identification strategy that assesses the level of intermediation across different asset classes and demonstrate that the marginal value of wealth of intermediaries primarily drives realized returns in more sophisticated asset classes. Furthermore, as suggested by Kargar (2021) and Ma (2023), the composition of the financial sector also plays a crucial role in explaining realized returns in stocks and bonds, but has a weaker impact on other asset classes like commodities. My paper extends this finding by demonstrating that the financial health of intermediaries can also explain variations in ex-ante measures of expected returns that directly capture investors' real-time return expectations, and whose dynamics may differ from those of realized returns. This suggests that intermediary-based models are ideal for explaining time-varying risk premia. Additionally, I connect this literature with research on the "financialization" of commodity markets. This allows me to provide empirical evidence on the time-varying nature of the relationship between intermediaries and expected returns, as well as on the importance of heterogeneity among intermediaries and shifts in market participation in impacting expected returns in commodity markets.

Lastly, this paper contributes to the literature that examines how the "financialization" of commodity futures markets has affected commodities and, consequently, the real economy (for a broad discussion and an early review of the literature, see Cheng and Xiong (2014)). On the empirical side, several papers, including Boons, De Roon, and Szymanowska (2014) and Büyükşahin and Robe (2014), have documented a significant shift in the correlation between commodities and stocks after "financialization". Moreover, Singleton (2014), Henderson, Pearson, and Wang

(2015b), Brogaard, Ringgenberg, and Sovich (2019) and Da et al. (2023), examine the effects of this increase in capital inflows from institutional and index investors on commodity futures prices, volatilites, and price informativeness. Similarly, on the theoretical side, Basak and Pavlova (2016) and Goldstein and Yang (2021) argue that the "financialization" of commodity markets led to changes in commodity futures prices, volatilities, price informativeness, and correlations among commodities and with other assets such as stocks. Lastly, Baker (2021) calibrates a macro-finance model for storable commodities and finds a decrease in their risk premium in response to "financialization". I contribute to this literature by analysing how the relevance of financial intermediaries in driving commodity risk premia changed around the "financialization". Specifically, I show that after the "financialization" the financial health of primary dealers is a less relevant driver of commodity subjective risk premia than it was before. On the other hand, the change in the mix of market participants and the entry of institutional investors during the "financialization" period led to different types of financial intermediaries, for example *non*-primary dealers, gaining increased importance over time in impacting commodity subjective risk premia. Hence, I highlight a connection between the "financialization" of commodity futures markets and heterogeneous intermediary asset pricing.

The paper is organized as follows. Section 3.2 describes the data used to construct commodity subjective risk premia and the measures of intermediary financial heath. Section 3.3 presents the main empirical strategies and results. Section 3.4 analyses the mechanism behind the patterns observed after the "financialization". Section 3.5 conducts robustness tests, while Section 3.6 explores extensions to the main analysis. Finally, Section 3.7 concludes.

3.2 Data

This section provides a description of the commodity futures and survey data, outlines the construction of subjective risk premia, and explains the measure of effective risk aversion employed to capture the health of financial intermediaries and to predict commodity subjective expected returns.

3.2.1 Commodity subjective expectations and risk premia data

I use commodity spot price forecasts to compute subjective expected excess returns on buy-and-hold futures positions. The consensus spot price forecasts are obtained from the Energy & Metals Consensus Forecasts by Consensus Economics. These surveys cover the period from August 1995 to December 2022 and serve as the data source for commodity futures markets (e.g., Nagel and Xu (2023)). The publication frequency of the surveys was quarterly before 2012, bi-monthly until 2015, and became monthly since 2016.[4] As common for surveys of professional forecasters, these forecasts represent the expectations of primary dealers (e.g., Citibank), commercial banks (e.g., ING Bank), financial advisors (e.g., Wilson HTM), and economic consulting companies (e.g., Oxford Economics). Hence, they potentially well reflect the expectations of financial intermediaries, i.e. the marginal investor in an intermediary-based framework.

Following Nagel and Xu (2023), and using a similar notation, I use the spot price forecasts to calculate the one-year expected excess returns from entering a one-year futures position at time t at the one-year futures price F_t and holding it until maturity $t+1$ (i.e., one year later) at the spot price S_{t+1}:[5]

$$\tilde{\mathrm{E}}_t[\mathrm{r}_{t,t+1}] = \frac{\tilde{\mathrm{E}}_t[\mathrm{S}_{t+1}]}{\mathrm{F}_t} - 1$$

where $\tilde{E}_t[S_{t+1}]$ represents the forecasted spot price from the Energy & Metals Consensus Forecasts data. The futures data are obtained from Datastream and Bloomberg. The one-year futures price (F_t) is the price at the end of date t of the next maturity contract at date $t+1$ (e.g., Bakshi, Gao,

[4] While the surveys are conducted regularly, there were some instances when they were not carried out on certain dates. For example, during the period August 2002 to March 2004, and in the third quarter of 2007, there are no forecasts available.

[5] As typical in commodity futures markets, the spot price S_{t+1} is proxied by a futures price very close to the spot price shortly before maturity.

and Rossi (2019)). In the remainder of the paper, the notation $t+1$ represents a one-year time horizon. However, it is important to note that the frequency of the data aligns with the frequency of the surveys, as described at the beginning of this section (i.e. ranging from quarterly to monthly over the sample period). To compute an unique subjective excess return for each commodity, I take the average across forecasters for each commodity on each survey date.[6]

I construct two portfolios to use as (separate) test assets by taking an equal-weighted average of the subjective expected excess returns across the commodities within each portfolio. More specifically, the first portfolio, labeled *Commodity Portfolio*, consists of oil and four metals (copper, gold, aluminium, silver). These commodities are the major components of the S&P GSCI index, and have the highest coverage and longest history in the Energy & Metals Consensus Forecasts surveys. The second portfolio, labeled *Commodity Portfolio Extended*, includes additional energy commodities (RBOB gasoline, gas oil, natural gas) and metal commodities (nickel, lead, zinc, tin), expanding the range of commodities beyond those included in the previous portfolio.

Descriptive statistics for these portfolios are presented in Table 3.1. Figure 3.1 plots the subjective excess return expectations. In the Appendix, I also provide descriptive statistics (Table 3.9) and plots (Figure 3.4) for the realized excess returns of the portfolios.[7] Consistent with what highlighted in the previous literature, subjective expected returns tend to be, on average, smaller and less volatile than realized excess returns. Moreover, they can be negative for extended periods.

3.2.2 Intermediary financial health

To address whether the financial health of intermediaries drives variation in subjective risk premia, I examine a proxy of intermediaries' effective risk aversion as predictor. This measure has been theoretically and empirically shown in previous literature to capture intermediary distress and to

[6] For robustness, I analyze the results when subjective excess returns are computed by taking the median across forecasters. As explained later, the findings of this exercise also indirectly speak at the accuracy of professional forecasters.

[7] Realized excess returns are computed similarly to subjective excess returns, but using ex-post realizations instead of ex-ante expectations: $r_{t,t+1} = \frac{S_{t+1}}{F_t} - 1$.

drive fluctuations in realized returns.

Specifically, my main predictor is the monthly *intermediary capital ratio* (henceforth, *icap*) from He, Kelly, and Manela (2017) (Figure 3.2). This variable is constructed as:

$$\text{icap}_t = \frac{\sum_p \text{Market Equity}_{p,t}}{\sum_p (\text{Market Equity}_{p,t} + \text{Book Debt}_{p,t})}$$

where, for each intermediary-p, market equity is calculated as number of shares outstanding multiplied by the stock price, and book debt is calculated as total assets minus common equity. Overall, *icap* is constructed by aggregating the balance sheets of the *primary*-dealers sector, which consists of financial intermediaries that serve as counterparties to the monetary policy operations of the Federal Reserve Bank of New York. These primary dealers, including Citigroup, J.P. Morgan, Goldman Sachs, and others, are large and sophisticated financial institutions that trade across numerous asset classes, employing sophisticated investment strategies. Furthermore, they operate with minimal transaction costs and rely on sophisticated models and extensive data to develop forward-looking expectations for asset return strategies. As a result, they possess the essential attributes to serve as marginal investors in multiple markets. Hence, the marginal value of their wealth likely provides a more informative stochastic discount factor compared to other agents.

For robustness, I also consider a second predictor, namely the measure of intermediary financial health proposed in Haddad and Muir (2021), which is available only at quarterly frequency. However, the results for this second proxy need to be taken with caution as in some periods there are mismatches between the quarterly dates in which the surveys are conducted and the quarterly dates in which this measure are observed. Given this and other limitations explained in Section 3.5.6, I primarily focus on the monthly intermediary capital ratio proposed by He, Kelly, and Manela (2017), which does not face these challenges.

As common in other papers, I compute the annual growth rates in the predictors and then take their negative values. This transformation allows me to interpret the final predictors as measures of average intermediary effective risk aversion. Shocks to these measures should then be associated with changes in expected returns, according to intermediary-based asset pricing theories. To briefly explain the economic logic behind this, consider the intermediary capital ratio (*icap*), which reflects the equity capital of primary dealers. Higher values of *icap* indicate a greater risk-bearing capacity and lower effective risk aversion. This condition drives down the intermediary's marginal value of wealth and, consequently, leads to lower expected returns on risky assets going forward.

As Haddad and Muir (2021), I also emphasise that I do not provide a detailed theory for what determines intermediary risk bearing capacity, despite the two measures being motivated in previous papers. My main goal is to use existing and well-established proxies (and theories) from the literature to test whether they can rationalize variation in subjective risk premia as measured by return expectations of professional forecasters.

3.3 Main empirical analysis

In this section, I analyse whether and how the subjective return expectations of the forecasters for an intermediated asset class, commodities, vary over time with the financial health of intermediaries.

3.3.1 Predictive regressions

To assess whether the financial health of intermediaries drives variation in subjective risk premia, I conduct in-sample predictive regressions of the return expectations on the predictors that capture intermediary effective risk aversion:

$$\text{risk premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1} \tag{3.1}$$

For ease of interpretation, I standardize the intermediary financial health predictors γ_j (with $j = \{icap,\ intermediaryra\}$) to have unit standard deviations. I present the results for my primary predictor, *icap*, in this section while reserving the results for the alternative measure, *intermediaryra*, for the robustness section (Section 3.5.6). Additionally, for each portfolio of commodities-i, I normalize the subjective risk premia by their full sample standard deviation, i.e. (subjective) $risk\ premia^{\sigma}_{i,t+1} = \frac{\tilde{E}_t[r^i_{t,t+1}]}{\sigma(\tilde{E}_t[r^i_{t,t+1}])}$. To account for autocorrelation and heteroscedasticity in the error terms, I use Newey and West (1987) standard errors adjustment (as done also in Xu (2020) and Adam, Matveev, and Nagel (2021), among others) with Andrews (1991) lag-length selection.[8]

This methodological approach parallels the in-sample predictive regressions conducted in the previous literature on subjective risk premia (e.g., Xu (2020), Adam, Matveev, and Nagel (2021) and Nagel and Xu (2023), among others). However, it distinguishes itself by recognizing that a significant portion of professional forecasters are financial intermediaries. Consequently, it utilizes the financial health of intermediaries as a potential predictor to explain variations in these subjective risk premia. Thus, while the methodology is similar, my framework departs from the previous literature on the dynamics of subjective risk premia as it aims at indirectly testing whether intermediary-based asset pricing theories can rationalize variations in the subjective return expectations of professional forecasters.

Similarly, this specification aligns also with the one used in Haddad and Muir (2021) and other studies in the intermediary-based literature. However, unlike these papers, my analysis employs the financial health of intermediaries to explain variations in direct measures of expected returns, which represent how investors perceive the dynamics of subjective risk premia in real-time, rather than ex-post measures as realized returns. As the literature of subjective risk premia has shown for the standard macro-finance framework, the dynamics of subjective risk premia might be different from that of ex-post (objective) risk premia (see Adam and Nagel (2023) for an overview of the discussion). Since time-varying risk premia models are about ex-ante expected excess returns, understanding the dynamics of these ex-ante survey-based measures of return expectations is of great importance for asset pricing. Utilizing the same specification as Haddad and Muir (2021)

[8] Results would be similar computing standard errors as in Hansen and Hodrick (1980).

allows me to compare my results with their existing findings on realized returns. This comparison aids in understanding if and how the dynamics of subjective expected returns diverge from theirs within this intermediary-based context.

In summary, the results of my analysis provide insights into how investors, particularly financial intermediaries, perceive the dynamics of subjective expected excess returns in real-time and whether these expectations can be rationalized within an intermediary-based asset pricing framework. Additionally, they allow to indirectly infer a potential information on which these marginal investors rely when forming their return expectations.

3.3.2 Baseline Results

Panel A of Table 3.2 presents the results. The health of financial intermediaries predicts one-year subjective excess returns in both the test assets. Specifically, when the health of financial intermediaries is in a bad state (i.e., when $\hat{\tilde{\gamma}}$ is high), subjective risk premia increase going forward. To provide an economic interpretation of the results, consider the estimated coefficient of 0.22 for the *icap* measure when the test asset is the *Portfolio Commodities Extended* (composed by energy + metals). Given that this portfolio has an average standardized subjective excess return of 0.21 (see Table 3.1), the estimated coefficient $\hat{\tilde{\gamma}}$ indicates that a one-standard deviation increase in the intermediary risk aversion measure is associated with a doubling of the standardized subjective risk premia. Similarly, standardized subjective risk premia in the other test asset would more than triple. Therefore, this effect is economically significant. Moreover, if anything, it is even larger than what previous papers have found for realized returns (see Haddad and Muir (2021)). This contrasts with findings in the subjective risk premia literature for many other predictors, as indicated by Nagel and Xu (2023), among others.

Overall, these results complement the recent literature on the dynamics of subjective risk premia by showing that return expectations of professional forecasters vary countercyclically in an intermediary-based asset pricing framework, where intermediaries are the marginal investors in (at least) sophisticated markets. Additionally, they offer indirect evidence that shocks to the financial health of the intermediary sector are a significant factor on which marginal investors, particularly financial intermediaries, rely when forming their expectations.

3.3.3 "Financialization" of commodity markets

After establishing a relationship between intermediary financial health and return expectations of professional forecasters, a natural question to ask is whether this relationship changes over time. Empirical evidence on the time varying nature of the link between financial intermediaries and expected returns are limited even in studies looking at realized returns. To address this point, commodity markets provide an ideal setting as they allow me to explore a rapid change over time in investors' types that occurred within the same market. This event is commonly referred to in the commodities literature as the "financialization" of commodity markets (see Basak and Pavlova (2016) and Goldstein and Yang (2021), among others).

Institutional background

Around 2004, commodity futures markets experienced a large and fast increase in investment inflows. For example, capital inflows from index investments grew from approximately \$20 billion in 2003 to over \$200 billion in 2008 (CFTC (2008), Stoll and Whaley (2010) and Irwin and Sanders (2011)). The total U.S. exchange-traded futures and futures option trading volume increased instead from around 630m contracts per year in 1998 to about 3.2b contracts per year in 2007, with growth observed across all commodities (CFTC (2008)). As shown by Boons, De Roon, and Szymanowska (2014) and Brogaard, Ringgenberg, and Sovich (2019), as well as similarly replicated in Figure 3.3, total open interest across commodities remained relatively flat between 1998 and 2003 but experienced a dramatic increase after 2004.

At the same time, and importantly for the purpose of this study, there was also a significant change in the mix of market participants, with a strong influx of institutional and index investors (see Domanski and Heath (2007), Irwin and Sanders (2011), Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019)). The entrance of traders such as pension and endowment funds, asset managements, mutual funds, hedge funds, commodity index traders, as well as retail investors, has altered the composition of participants in the market (see CFTC (2008), Büyükşahin and Robe (2014), Brunetti, Büyükşahin, and Harris (2016), and Goldstein and Yang (2021)). As of 2008, approximately 24% of the total net notional value of funds invested in commodity indexes was held by "Index Funds", and around 42% was held by "Institutional Investors" (CFTC (2008)).

Overall, this change in market structure and the significant influx of capital has been dated in 2004 (e.g., Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019)) and is referred to as the "financialization" of commodity futures markets in the academic literature.

The consequences of this event are still the subject of debate among academics, regulators, and practitioners. This paper deviates from previous academic literature as it explores how the relation between financial intermediaries and subjective return expectations of professional forecasters changed around this shift in the mix of market participants.

Empirical analysis

In order to explore the role of the "financialization" of commodity markets on the relevance of intermediaries for commodity subjective risk premia, I augment the empirical specification in (1) as follows:

$$\text{risk premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times \text{DF}_t) + d_{i,j}\text{DF}_t + \epsilon_{i,t+1} \tag{3.2}$$

where DF_t is dummy variable that takes the value 1 after the occurrence of the "financialization" in 2004 and 0 before (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others, on the choice of this date). I interact this dummy with the measures of intermediary effective risk aversion $\tilde{\gamma}_{j,t}$. Consequently, the coefficient $c_{i,j}$ represents the marginal contribution of the financialization to the relevance of intermediary effective risk aversion in driving subjective return expectations.

To ensure a balanced sample before and after the "financialization" and to exclude any potential confounding periods during the post-"financialization" era, I apply the above specification to a sample period that concludes at the onset of the Global Financial Crisis (GFC)[9], in addition to analyzing the full sample period of the data.

The results are presented in *Panel B* of Table 3.2. The findings show that, before the financialization, the financial health of intermediaries, particularly primary dealers, strongly explains variation in subjective risk premia. The coefficient $b_{i,j}$ associated with the measure of effective risk aversion $\tilde{\gamma}_{j,t}$ is positive and economically significant across portfolios. The estimate is larger than in the specification that does not account for the effect of the financialization. This is because the marginal contribution of the financialization, represented by the coefficient $c_{i,j}$ attached to the interaction term, is negative and quantitatively significant. Specifically, a one-standard deviation increase in the intermediary risk aversion measure is associated to a three to six times increase in the standardized subjective risk premia before financialization ($\hat{b}_{i,j}$ coefficient), but a marginal decay after the financialization of two to four times the full sample average ($\hat{c}_{i,j}$).[10]

In Section 3.4, I will show that, while the importance of primary dealers decreases with the change in the mix of market participants occurred around the financialization, the relevance of the financial health of other types of intermediaries, e.g. *non*-primary dealers, exhibits very different dynamics. Additionally, I will show that this decay observed for the financial health of primary dealers is not present in the return expectations on non-index commodities, i.e. in those commodities that were less affected by the financialization.

In summary, the results of this section demonstrate that while shocks to the financial health of the intermediary sector play key a role in driving variation in subjective risk premia in commodities,

[9] The results remain robust when considering both mid-2007 (e.g., RBA and FED NY) or December 2007 (NBER recession) as the initial date of the global financial crisis.

[10] Table 3.10 in the Appendix shows a similar finding when running the specification in (1) for two subsamples: before and after the financialization of commodity markets. In the pre-financialization period, the estimated coefficient attached to $\tilde{\gamma}$ is more than two times larger, indicating a higher relevance of financial intermediaries, specifically primary dealers, for subjective risk premia. In the post-financialization period, the coefficient remains lower even after the global financial crisis.

their relevance may change over time.[11] Hence, this result provides novel empirical evidence of the time-varying nature of the relationship between intermediary financial health and expected returns.

3.4 Exploring the "financialization" decay: potential mechanisms

This section explores potential mechanisms that contribute to the decline in the relevance of intermediaries, mainly primary dealers, in driving subjective expected returns of commodities following the "financialization" (as observed in Section 3.3.3). Two main drivers are investigated, both associated with the changing composition of market participants around this event. The first driver relates to the increasing role of other types of intermediaries, for example standalone broker-dealers (i.e., non-primary dealers), occurred with the change in the mix of market participants. The second driver pertains to the increase in the inflow of slow-moving capital into the market through index investing.

3.4.1 *Non-primary* dealers

As discussed in Section 3.3.3, there was a strong entrance of institutional investors in commodity markets with the "financialization". Institutional traders, including pension funds, mutual funds, hedge funds, and commodity trading advisers, increased their participation in the commodity futures markets and altered the composition of market participants (see CFTC (2008), Büyükşahin and Robe (2014), Brunetti, Büyükşahin, and Harris (2016) and Goldstein and Yang (2021), among others).

[11] Table 3.11 in the Appendix shows that the results remain robust even when constructing subjective expected returns by taking the median across forecasters for each commodity, rather than the mean. Therefore, it appears that, differently from individual forecasters, professional forecasters are on average potentially accurate (see also Buraschi, Piatti, and Whelan (2022) and Bastianello (2022) for a similar conclusion). This finding indirectly speaks at the evidence in Heyerdahl-Larsen and Illeditsch (2021), where the authors suggest that accounting for the heterogeneity in accuracy among individual forecasters helps reconcile the wedge in cyclicality between objective and subjective risk premia within a macro-finance framework.

In Section 3.2.2, I explained that the intermediary financial health measures primarily focus on primary dealers, such as JP Morgan or Goldman Sachs, which are large and sophisticated financial institutions operating across capital markets. Consequently, one possible explanation for the decline in the relevance of intermediaries in driving subjective risk premia after the financialization is that primary dealers experienced a diminished role as marginal investors, likely due to the entry of other institutional investors.

To investigate this possibility, I explore a placebo test conducted in He, Kelly, and Manela (2017) comparing the role of primary dealers to *non*-primary dealers for realized returns. The authors demonstrate that the measure of intermediary financial health derived from the balance sheets of *non*-primary dealers explains cross-sectional variation in realized returns in only a few markets.[12] In contrast, the financial health of primary dealers significantly influences the cross-section of many markets. *Non*-primary dealers such as Blackrock, Charles Schwab, and Waddell & Reed, are smaller, standalone broker-dealers that are less likely to trade extensively across asset classes and act as marginal investors in financial markets. Since the measure of their financial health captures the relevance of a different subset of institutional investors, closer to asset managements, it can provide valuable insights into the changes that occurred in the commodity markets with the shift of market participants during the financialization. Therefore, I incorporate it into my framework as follows.

I start by constructing the measure of financial health for *non*-primary dealers, labeled as *icap-nonprim*. In order to do so, I identify intermediaries based on the SIC codes of US broker-dealers, specifically codes 6211 ("security brokers, dealers, and flotation companies") and 6221 ("commodity contracts brokers and dealers"). From this pool of financial intermediaries, I exclude the primary dealers (as listed on the NY FED website). Using balance sheet information from CRSP/Compustat, I then construct the monthly *intermediary capital ratio* as described in Section

[12] Specifically, they use data on realized returns from approximately 1970 to just after the financial crisis, around 2012. Their findings indicate that the capital risk factor of *non*-primary dealers is priced only in few specific markets, such as equity, options, and credit default swaps (CDS). The price of risk in commodities, instead, is relatively weaker and lacks statistical significance.

3.2.2, but only for the remaining standalone broker dealers (i.e., *non*-primary dealers) in the pool. This resulting measure, *icap-nonprim*, proxies for *non*-primary dealers' effective risk aversion. I then repeat the analysis of Section 3.3, but using this new variable as predictor.

The results are reported in Table 3.3 and can be summarized as follows. Over my entire sample, the financial health of *non*-primary dealers drives variation in subjective expected returns in commodity markets. However, this finding conceals more complex dynamics. Specifically, *non*-primary dealers do not play a significant role until the aftermath of the financialization. Their relevance in impacting subjective risk premia increases over the longer term following the financialization (even when excluding the period of the Global Financial Crisis from the analysis, see Table 3.14). In contrast, primary dealers (Section 3.3.3) appear relevant for subjective risk premia before the financialization but less so after. This highlights that different types of intermediaries impact differently the dynamics of the subjective return expectations. Hence, the source of information on which investors rely to form their expectations potentially changes over time, in conjunction with shifts in the composition of market participants. Additionally, this result indirectly suggests that the role of primary dealers as marginal investors in commodity markets potentially decreased following the change in the mix of market participants, while that of different types of intermediaries slowly increased. This evidence also further reinforces the findings presented in the previous section regarding the time-varying nature of the relationship between intermediary financial health and subjective risk premia.[13]

To make a more direct comparison between the relevance of primary and non-primary dealers' financial health, in Table 3.15 I compare how the two measures predict subjective risk premia within a single specification that includes them both simultaneously. The results align with the previous analysis. Prior to the financialization period, it is mainly the financial health of primary dealers that impacts the return expectations of professional forecasters. However, in the post-

[13] The results in Table 3.13 support the increased significance of non-primary dealers' risk aversion after the financialization, albeit with a lag, not limited to the financial crisis. Furthermore, the results remain robust when constructing the subjective expected returns by taking the median across forecasters instead of the average (Table 3.12).

financialization era, the importance of primary dealers' financial health diminishes, while that of non-primary dealers' financial health increases over time. Interestingly, on average, the financial health of non-primary dealers appears to play a more significant role. This observation could be attributed to the fact that the dataset covers a substantially longer post-financialization period compared to the pre-financialization period.

Additionally, my findings highlight the importance of accounting for heterogeneity among financial intermediaries when studying the relevance of intermediary financial health in driving commodity subjective risk premia. Therefore, these results are connected and complement recent papers by Kargar (2021) and Ma (2023), which show that the composition of the financial sector has important asset pricing implications beyond the health of the aggregate financial sector.[14] Empirically, the composition of the financial sector has indeed both time series and cross-sectional explanatory power for realized returns, but mainly in stocks and bonds, while not in other asset classes such as commodities.

I then establish a more direct connection between my findings on the increasing relevance of *non*-primary dealers for commodity subjective risk premia after the financialization and the literature on heterogeneous intermediary asset pricing. To this goal, I construct a proxy of the wealth share of the more aggressive intermediary (i.e., the broker dealers) as a fraction of the total financial sector using monthly data. The measure is defined as:

$$\text{intermheterog}_t = \frac{\text{Market cap of dealers}_t}{\text{Market cap of the financial sector}_t}$$

where publicly traded broker dealers are identified as the US firms in the CRSP universe with SIC codes 6211 ("security brokers, dealers, and flotation companies") or 6221 ("commodity contracts brokers and dealers"), and the financial sector consists of firms in the CRSP universe for which the first two digits of the header SIC code are between 60 and 67. This variable is inspired by

[14]While, closely related, Weber (2023) emphasizes the importance of the degree of institutional ownership, in comparison to household ownership, in driving time-varying equity expected returns as measured by realized returns.

a monthly measure discussed in Kargar (2021). Then, I repeat the analysis using this proxy for intermediary heterogeneity as predictor.

The results, presented in Table 3.4, demonstrate that the significance of the financial sector's composition in driving commodity subjective risk premia increases notably over time following the financialization, although not immediately after its occurrence (but not solely during the global financial crisis period, see Table 3.14).[15] The mix of market participants changed indeed substantially over time with the financialization of commodity markets, resulting in increased heterogeneity among intermediaries. *Non*-primary dealers gained relevance in impacting subjective risk premia, while primary dealers lost it. Therefore, over time, this increase in heterogeneity potentially enhanced the importance of the composition of the financial sector in driving subjective expected returns in this market.

In summary, heterogeneity across intermediaries plays a relevant role for the dynamics of commodity subjective risk premia. Around the financialization of commodity markets, the prominence of primary dealers in driving subjective risk premia has decreased while that of other types of intermediaries, e.g. non-primary dealers, has increased. Investors potentially change the information on which they condition their expectations over time. Overall, my findings in this section highlight the complex relationship between intermediary heterogeneity and the financialization of commodity markets on one hand, and subjective risk premia on the other.

3.4.2 Index investing

As discussed in Section 3.3.3, the financialization was characterised by significant capital inflows into commodity indexes, such as the S&P Goldman Sachs Commodity Index or the Dow Jones UBS Commodity Index. Consequently, to shed further light on the observed decay in the relevance of primary dealers, a potentially informative exercise is to analyse the dynamics of the return

[15] Kargar (2021)'s sample for commodities covers around 40 years of data, with almost three quarters belonging to the pre-financialization period. Thus, not only his focus is on realized returns, but also his sample is significantly more influenced by the pre-financialization era than mine.

expectations of professional forecasters for non-index commodities, i.e. for those commodities less influenced by the financialization.

Therefore, I conduct an analysis similar the one in Section 3.3.3 but now focusing on a portfolio of non-index commodities (i.e., of commodities that do not constitute a major commodity index). However, it is important to note that this exercise faces data limitations, as the sample of non-index commodities included in the Consensus Economics surveys, for which also a futures price is available to compute the subjective excess returns, is limited and noisy. Specifically, I examine two non-index commodities, Tin and Platinum, available for the period of 1996 to 2022, along with three non-index commodities, Palladium, Coal, and Steel, for which data series start at a later part of the sample. I construct a non-index commodity portfolio by taking the equal-weighted average of their subjective excess returns. The results are presented in Table 3.5.

Primary dealers' financial health partly explains variation also in subjective risk premia of these non-index commodities, on average. However, when investigating changes in this relationship around the financialization period, a different pattern emerges compared to Section 3.3.3. Contrary to before, there is no longer a decrease in the relevance of primary dealers' financial health. If anything, the effect appears to be moving in the opposite direction right after financialization. Nevertheless, before financialization, while the economic relevance of primary dealers is present also for expectations on non-index commodities, the effect is not statistically significant. Overall, these findings, although requiring a degree of caution, indicate that the decline in the significance of primary dealers' financial health in impacting the return expectations of professional forecasters is primarily noticeable for commodities that experienced a greater impact from financialization (i.e., index commodities). Moreover, the results suggest that the influx of slow-moving capital into index commodities may potentially reduce the direct impact of primary dealers on expected returns, albeit to a much lesser extent than the increased importance of various other types of financial intermediaries.

3.5 Robustness

This section conducts robustness tests on the main analysis presented in Section 3.3.

3.5.1 Continuous Financialization Variable

Specification (2) employs a dummy variable to capture the effect of the "financialization". However, as discussed in Section 3.3.3, the "financialization" of commodity futures markets is not necessarily a discrete event that occurred immediately in 2004, but rather a rapid and substantial influx of capital that took place in an unprecedented manner within only a few years after that date. Therefore, as a robustness check, I construct an alternative continuous measure of "financialization" (DFOI_t). This new variable is designed to take the value 0 before the date commonly employed as the initial date of "financialization" in the academic literature (i.e., January 2004, see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). It takes the value 1 after the end of 2007, signifying the period when the sudden increase in capital inflows reached a peak. Between these dates, it assumes values equal to the (standardized) growth in open interest. By employing the growth in open interest as a proxy, I can capture the significant increase in capital inflows documented in the literature during the "financialization" period (see, for example, CFTC (2008) and Brogaard, Ringgenberg, and Sovich (2019) for a similar interpretation of this measure).

Tables 3.17 and 3.18 present the results for the financial health of primary and non-primary dealers, respectively. The findings remain qualitatively similar to those observed in Section 3.3.3. On one hand, the financial health of primary dealers significantly impacts the dynamics of return expectations of the professional forecasters before the financialization, but its relevance diminishes afterward. On the other hand, the financial health of non-primary dealers is not significant before the financialization, but its importance increases over time, albeit not immediately in the aftermath of the financialization. Overall, the results confirm the time-varying nature of the relationship between intermediaries and subjective return expectations, as well as as the importance of accounting for heterogeneity among financial intermediaries when studying the dynamics of risk premia.

3.5.2 Changes in the sensitivity of intermediaries to the measure of effective risk aversion

A potential concern is that around the "financialization" there might have been a break in how the capital ratio of intermediaries maps into the level of effective risk aversion. In other words, the sensitivity of primary dealers to the measure of effective risk aversion might have experienced a change that could alter the estimated relevance of this measure on subjective risk premia around the financialization.

To address this concern, I construct a proxy of the sensitivity of how the capital ratio of primary dealers changes with their stock risk premia over time by estimating the following out-of-sample regression:

$$\text{Dealers risk premia}^{\sigma}_{t+1} = a_t + s_t \tilde{\gamma}_t + \epsilon_{t+1}$$

where Dealers risk premia$^{\sigma}_{i,t+1}$ is a portfolio of excess returns of the primary dealers from which the risk aversion measure is constructed. $\hat{s}_t$ is then the resulting proxy of sensitivity over time.

I then augment the regression in (2) to control for this potential change in the sensitivity of intermediaries to the measure of effective risk aversion:

$$\text{risk premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}\hat{s}_t + \epsilon_{i,t+1}$$

Table 3.19 reports the findings. Overall, the relevance of primary dealers in driving commodity subjective risk premia before the financialization, and the decrease in this relationship afterwards, continue to hold.

3.5.3 Changes in hedging pressure, open interests and liquidity

Commodity markets are potentially characterized by a risk premium paid by hedgers to unload their risks to speculators (Keynes (1930a) and Hicks (1939)). Empirical tests of this view require speculators to refrain from hedging and primarily engage in speculation to accommodate hedging needs. In contrast, the intermediary-based view of the market does not necessarily rely on these assumptions.

However, the "financialization" of commodity markets, in theory, may have reduced the premium paid by hedgers by increasing speculation in the market. While evidence on the existence of a hedging pressure premium is mixed and subject to ongoing debate, recent progress has been made by Kang, Rouwenhorst, and Tang (2020), which uncovers the existence of two premia within hedging pressure. The authors find that the liquidity premium, which constitutes part of the hedging pressure premium, remains unchanged around the financialization. Furthermore, Baba Yara and Bondatti (2022) do not observe a decrease in the hedging pressure premium when examining changes in commodity trading strategy returns around the financialization. Nevertheless, as these studies focus on realized returns rather than subjective return expectations, I repeat the test in (2) while controlling for hedging pressure. The hedging pressure measure, constructed according to Szymanowska et al. (2014) using data from the Commodity Futures Trading Commission (CFTC), is given by:

$$\text{hp}_t = \frac{\#\text{short hedge positions} - \#\text{long hedge positions}}{\text{total } \# \text{ short hedge positions}}$$

Additionally, as previously mentioned, the financialization of commodity markets was accompanied by a rapid increase in capital inflows. Therefore, I use an aggregate measure of open interest, constructed from CFTC data, as a proxy for inflows and include it as a control variable in the specification in (2).

Lastly, I control for potential changes in aggregate liquidity using the liquidity factor of Pástor and Stambaugh (2003).

The results of these two robustness tests around the financialization are presented in Tables 3.20, 3.22 and 3.24, for the financial health of the primary dealers, and in Tables 3.21, 3.23 and 3.25 for the financial health of the *non*-primary dealers. The findings of Section 3.3.3 continue to go through. The impact of hedging pressure, open interest and liquidity on subjective risk premia is weak, even when analyzing a period limited to the aftermath of the financialization. However, the significance of primary dealers' effective risk aversion in explaining variation in subjective expected returns and the marginal decay of this relationship after the financialization persist. Similarly, the *non*-primary dealers' effective risk aversion continues to impact the return expectations mainly after the "financialization" of commodity markets.

3.5.4 Extrapolation from past expectations and past returns

Extrapolation from recent past expectations and recent past returns play an important role in return expectations data (see Greenwood and Shleifer (2014), among others).

Therefore, first, I repeat the main analysis by including past one-year subjective expected returns as an additional predictor in specifications (1) and (2). The results are presented in Table 3.26 and are as follows: past return expectations positively predict future return expectations. However, even after accounting for extrapolation from past expectations, subjective risk premia still countercyclically vary with respect to intermediary effective risk aversion. Furthermore, when focusing on the aftermath of the financialization, the decrease in the relevance of primay dealers risk aversion is still economically and statistically present, while past return expectations do not play a significant role in driving subjective risk premia around this event. Only in the long run extrapolation from past return expectations diminishes the marginal impact of intermediary risk aversion on the return expectations of the professional forecasters.

Second, I replicate the analysis by including past-one year realized returns as an additional predictor. The outcomes are presented in Table 3.27. Consistent with the findings of previous literature, return expectations of professional forecasters appear strongly contrarian with respect to recent past excess returns. The influence of extrapolation from past realized returns seems to overshadow the impact of financial intermediaries, with the global financial crisis and COVID-19 periods (and their aftermath) mainly driving this outcome. However, when separating the post-financialization decline, on average there is still a significant role for intermediary financial health in driving variation in subjective expected returns. Additionally, extrapolation from past realized returns does not drive away the decline in the role of intermediaries following the financialization.

Overall, as also highlighted by Greenwood and Shleifer (2014), Jin and Sui (2022) and Andonov and Rauh (2022), recent past returns and recent past return expectations have an important influence on subjective return expectations and therefore warrant further research in the subjective risk premia literature.[16] However, the health of financial intermediaries also plays a crucial role in impacting the dynamics of return expectations of professional forecasters in commodity markets.

3.5.5 Business Cycle Fluctuations and Household Risk Aversion

Prior intermediary-based literature has primarily focused on the importance of financial intermediaries for asset prices and realized returns, as intermediaries are natural candidates to be marginal investors across financial markets. Haddad and Muir (2021) take a step further by assessing their relevance depending on the degree of sophistication (i.e., intermediation) of different asset classes. The idea is that the more sophisticated an asset class is, the more intermediaries (rather than other agents) should matter for its prices. To do so, they employ an identification strategy across different asset classes, ranking them by the level of intermediation. They demonstrate that intermediary financial health has a more pronounced impact on more sophisticated assets like MBS, CDS, or commodities, while household financial health is more relevant for less sophisticated assets such as equities. This empirical approach allows them to mitigate the issue of multicollinearity between the two distinct types of financial health.

[16] An important caveat to emphasize regarding the relevance of extrapolation from past return expectations and realized returns is that, in turn, both of them may be influenced by the past financial health of intermediaries.

Due to my data limitations, I do not have information on return expectations for other asset classes, preventing me from adopting the same empirical strategy. However, to shed further light on the relevance of financial intermediaries compared to households, I directly extend the specifications presented in equations (1) and (2) to include consumption growth (which is also available at monthly frequency). Additionally, to be as restrictive as possible, I also simultaneously incorporate business cycle variables as controls, which could potentially predict commodity returns, specifically industrial production and the term spread.

Table 3.28 presents the results of this robustness analysis when the main predictor is the financial health of the primary dealers. On average, none of the four predictors appear to be statistically significant. Notably, the financial health of primary dealers and industrial production exhibit stronger economic significance. However, this outcome suggests a potential issue of multicollinearity. Importantly, when I separate the ”financialization” effect, the financial health of primary dealers remains a relevant factor in explaining return expectations before the financialization, with the highest economic impact among the predictors. Moreover, its significance continues to diminish considerably after the financialization period. Lastly, when the primary predictor is the financial health of the *non*-primary dealers (Table 3.29), the results consistently support the significance of this state variable in capturing time-variation in return expectations. This still holds true on average and, especially, over time following the period of financialization. Hence, while subject to caution, these results still highlight the crucial role played by intermediaries in shaping return expectations of professional forecasters (hence, of intermediaries) and the importance of accounting for time variation in this relationship.

3.5.6 Alternative measure of intermediary financial health

For robustness, I examine an alternative proxy of intermediary financial health proposed in Haddad and Muir (2021), which I label *intermediaryra*. This measure, is constructed from the quarterly intermediary capital ratio of He, Kelly, and Manela (2017) and the quarterly broker-dealer leverage factor of Adrian, Etula, and Muir (2014). The two measures are standardized and averaged to obtain the final proxy.

However, due to the quarterly nature of *intermediaryra*, caution is required when interpreting the results for this measure. This is because in some periods there are mismatches between the quarterly dates in which the surveys are conducted and the quarterly dates in which the measure is observed.[17] Additionally, the recent studies on heterogeneous intermediaries and asset prices (see Kargar (2021) and Ma (2023)) have shown that the two measures averaged in *intermediaryra* may capture distinct dynamics. As my findings emphasize the significance of intermediary heterogeneity for subjective risk premia, the monthly *icap* measure of He, Kelly, and Manela (2017) represents a more suitable baseline.

Nevertheless, I repeat the main analysis using as predictor this second proxy of intermediary financial health (i.e., *intermediaryra*). The results are presented in Tables 3.30 to 3.32. Due to space constraints, Table 3.31 reports the financialization analysis with controls only up to the global financial crisis. Overall, the findings in Section 3.3 for the *icap* measure remain consistent. Specifically, financial intermediaries are important in explaining the dynamics of subjective risk premia, but their relevance diminishes around the financialization. Hence, also this results highlight the importance of intermediary financial health as a driver of the return expectations of intermediaries, albeit with variations over time, and as an information on which they potentially condition to form their expectations.

3.6 Extensions

In this section, I extend the main analysis to explore the granularity of the Consensus Economics data. Specifically, I delve into the fact that the surveys enable the observation of expectations

[17] As a result, either the observations for the quarterly *intermediaryra* measure are leaded/lagged to match the dates of the surveys, resulting in a sample period that partly covers different months, or some dates do not have a match between the return expectations and the quarterly intermediary measure, leading to missing observations.

from individual intermediaries. Consequently, I aim to understand how the expectations of individual institutions or different groups vary with respect to the different measures of intermediary financial health. The results of this analysis provide insights into the degree of homogeneity across expectations.

3.6.1 Panel Tests

To explore the panel dimension of the Consensus Economics data, I conduct panel tests using the subjective return expectations of each forecaster, denoted as f, for each commodity, denoted as i. Specifically, I consider all twelve commodities included in the *Portfolio Commodities Extended.*

First, I estimate the following panel regressions:

$$\text{risk premia}^{\sigma}_{f,i,t+1} = b \times \tilde{\gamma}_t + \eta_f + \psi_i + \epsilon_{f,i,t+1}$$

$$\text{risk premia}^{\sigma}_{f,i,t+1} = b \times \tilde{\gamma}_t + c\left(\tilde{\gamma}_t \times DF_t\right) + d \times DF_t + \eta_f + \psi_i + \epsilon_{f,i,t+1}$$

where η_f represents forecaster-f fixed effects, and ψ_i are commodity-i fixed effects. In this setup, the individual subjective return expectations for each commodity are regressed on the average financial health of primary dealers first and then on the average financial health of *non*-primary dealers. This specification allows for the disentanglement of the financialization impact and mirrors the time-series tests conducted in the main analysis. Standard errors are clustered by forecaster.

The results of these panel tests are reported in Table 3.6. Despite smaller magnitudes, partly due to the absorbing nature of the fixed effects, the results corroborate the primary findings: the financial health of primary dealers impacts return expectations on average, and especially before financialization, while the financial health of *non*-primary dealers becomes relevant over time after financialization. Additionally, these results suggest potential homogeneity among expectations.

In the Appendix, a separate panel test is conducted. I match, when possible, forecasters in the Consensus Economics data with their own financial health. The final subset primarily comprises of primary dealers. Then, I estimate the following panel regression of each forecaster's subjective risk premia against its own financial health:

$$\text{risk premia}^{\sigma}_{f,i,t+1} = b \times \tilde{\gamma}_{f,t} + \eta_f + \psi_i + \epsilon_{f,i,t+1}$$

where η_f represents forecaster-f fixed effects, and ψ_i are commodity-i fixed effects. Standard errors are clustered by forecaster. The results of these panel tests are reported in Table 3.16. Similarly, it appears that the worse the financial health of the individual forecaster, indicating a higher effective risk aversion $\tilde{\gamma}_{f,t}$, the higher the returns the forecaster subjectively expects to earn to invest in risky assets like commodities.

Overall, the results from this section reinforce the significance of intermediary financial health in impacting the subjective return expectations of the intermediaries providing forecasts, while also showing a certain degree of homogeneity among the expectations.

3.6.2 Separating the Expectations

As the professional forecasters represent different types of intermediaries, I delve further into the question of whether these survey-based expectations are homogeneous in nature.

Consequently, I also extend the analysis in Section 3.3 by explicitly distinguishing between the expectations of primary dealers and those of other professional forecasters, including various types of intermediaries (e.g., commercial banks, financial advisors, etc.), within the Consensus Economics survey data. I construct subjective risk premia separately for these two categories and repeat the main analysis to investigate how the financial health of primary dealers and of non-primary dealers drives the return expectations of each subgroup of professional forecasters. The results are as follows.

Table 3.7 demonstrates that return expectations of both primary dealers and other professional forecasters similarly vary with the financial health of primary dealers, and particularly before the financialization. Especially when examining the aftermath of financialization, it appears that the relevance of primary dealers' effective risk aversion in driving all the return expectations decreases, although the decay is weaker for the primary dealers' expectations. Qualitatively, these findings parallel the results in Section 3.3 for the average expectations across all professional forecasters.

Table 3.8 presents instead the results for the financial health of non-primary dealers and shows a similar pattern to Section 3.4.1. The return expectations of both subgroups of professional forecasters vary with the health of non-primary dealers. However, while the relevance of non-primary dealers' financial health is not evident before the financialization of commodity markets, it increases over time, although not immediately following the financialization. The economic magnitudes of the effect are similar for the return expectations of the two different subgroups.[18]

Overall, the results of this analysis reinforce the finding that the return expectations of various types of professional forecasters are similarly driven by the financial health of different intermediaries. Various financial intermediaries condition their return expectations on shocks to the intermediary sector's capital in a comparable manner. Hence, intermediaries' expectations for commodity excess returns appear to exhibit a substantial degree of homogeneity in the way they rely on these shocks. This evidence also helps mitigate potential concerns about the results being solely associated with a particular subgroup of forecasters or about the aggregation of expectations when examining averages.

3.7 Conclusions

I show that the subjective return expectations of professional forecasters for a sophisticated asset class, commodities, are impacted by shocks to the financial health of intermediaries. This rela-

[18] Table 3.33 shows that the results for the heterogeneity among intermediaries (i.e., on the importance of the composition of the financial sector) in Section 3.4.1 hold also when separating the expectations of the two different types of professional forecasters.

tionship exhibits time variation and is contingent upon changes in the composition of financial intermediaries participating in the market. On average, the financial health of primary dealers plays an important role in explaining variation in the commodity subjective risk premia. However, following the "financialization" of commodity markets, which was characterized by a substantial increase in institutional and index investor participation, the significance of primary dealers diminishes. Conversely, the financial health of other financial intermediaries, such as non-primary dealers, gains prominence in impacting commodity return expectations over time post-"financialization". These findings unveil a novel driver for the dynamics of subjective risk premia in intermediated asset classes, providing empirical support for the relevance of financial intermediaries and their heterogeneity in understanding asset prices behavior. As the expectations of the professional forecasters reflect in large part expectations of financial intermediaries, the evidence presented in this study also sheds light on the information sources these marginal investors potentially rely on when forming their beliefs and producing forecasts. As also argued in Adam and Nagel (2023), understanding the expectations of intermediaries is a critical avenue for future research, given their influence on asset prices, asset allocation decisions (see Wang (2021) and De Marco, Macchiavelli, and Valchev (2022)), and real outcomes like lending (see Ma, Paligorova, and Peydro (2021)).

While this work represents an initial step in connecting the return expectations of professional forecasters with an intermediary-based asset pricing framework, future research could explore the applicability of this relationship across diverse asset classes characterized by varying degrees of intermediation. Additionally, it would be interesting to investigate potential variations in the properties of subjective return expectations among different market participant groups, including individual investors and various categories of professional investors (e.g., pension funds, insurance companies, hedge funds, etc). Lastly, it would be useful to study how the financial health of specific institutional investors that entered commodity markets more robustly around the "financialization" (such as pension funds, endowment funds and hedge funds) drives the return expectations on commodities over time. This analysis would provide insights into which specific type of intermediary predominantly assumes the role of marginal investors in commodity futures markets post-"financialization".

3.8 Tables and Figures

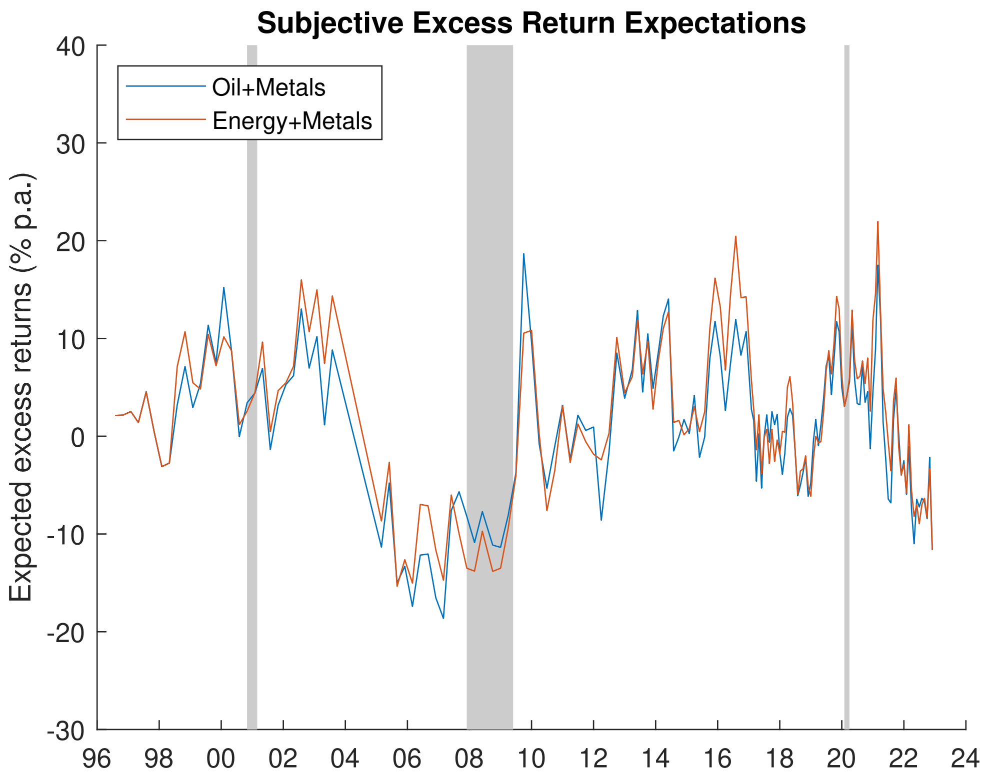

Figure 3.1: Subjective Excess Return Expectations

This figure plots the subjective excess return expectations implied by the Consensus Economics surveys of professional forecasters of each portfolio of commodities. Grey-shaded areas indicate recessions. The expected excess returns are over the one-year horizon. Descriptive statistics are reported in Table 3.1.

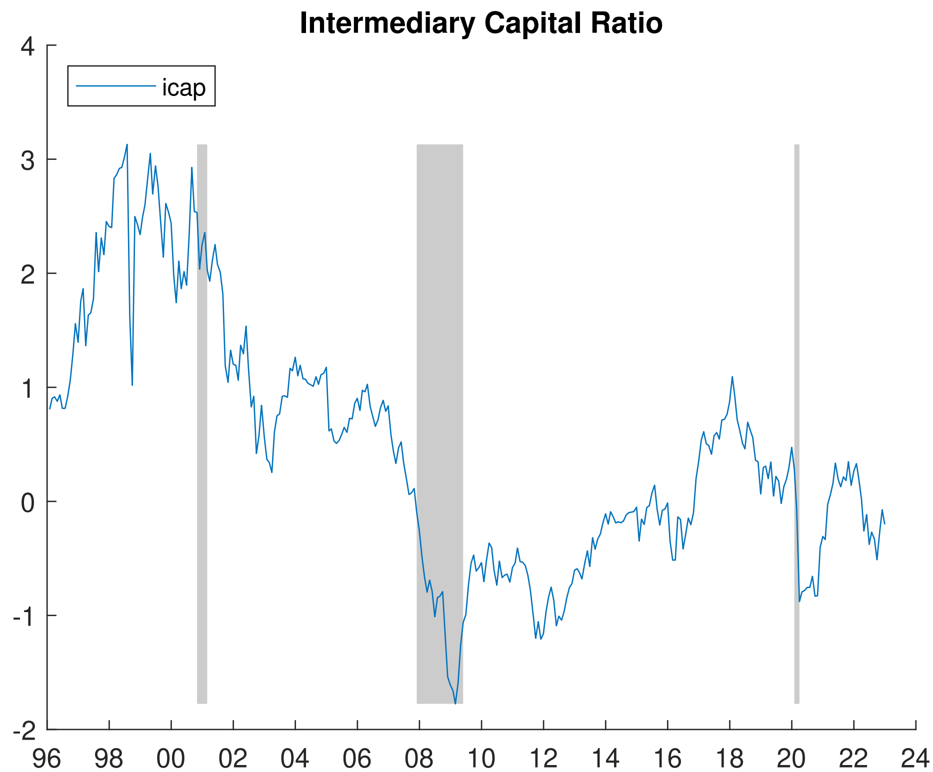

Figure 3.2: Intermediary Capital Ratio

This figure plots the standardized monthly intermediary capital ratio of He, Kelly, and Manela (2017). Grey-shaded areas indicate recessions.

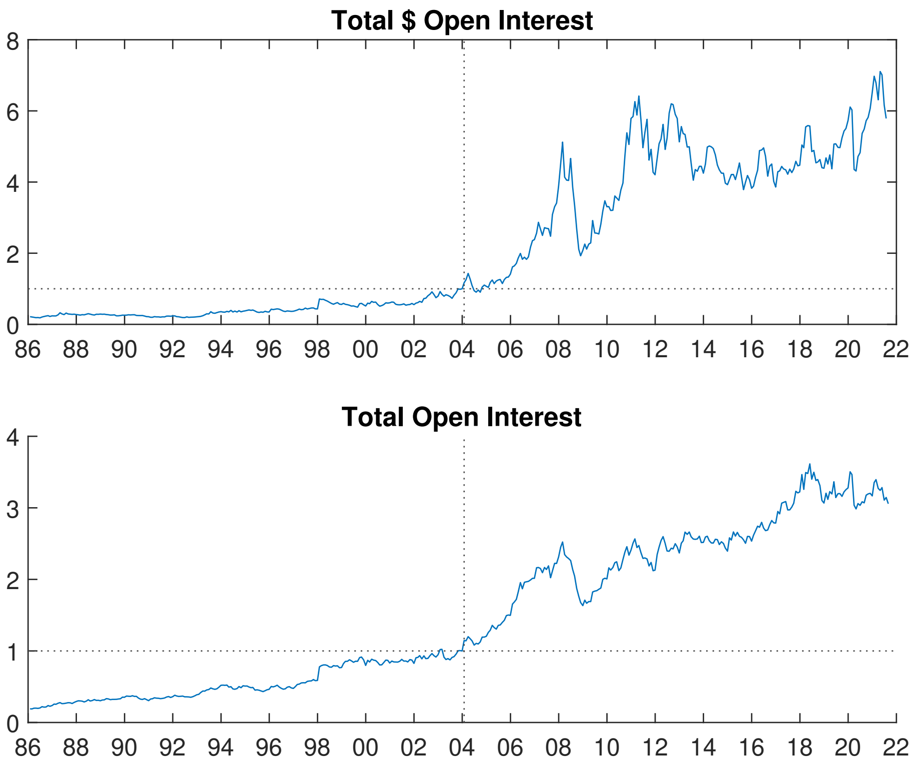

Figure 3.3: Total Open Interest

This figure plots the sum of open interest over time. The data cover the period 03/1986-12/2022 and are retrieved from the Commodity Futures Trading Commission (CFTC).

Table 3.1: Descriptive Statistics of Commodity Excess Returns Expectations
This table reports the one-year subjective excess returns as implied by the survey expectations of professional forecasters. I report the one-year excess returns on the two portfolios constructed. For each portfolio, the table reports the name, the survey used, the sample period, the mean (in %), the standard deviation (in %) and the standardized mean.

Portfolio	Source	Sample Period	$E[\tilde{E}_t[r_{t,t+1}]]$	$\sigma(\tilde{E}_t[r_{t,t+1}])$	$\frac{E[\tilde{E}_t[r_{t,t+1}]]}{\sigma(\tilde{E}_t[r_{t,t+1}])}$
Commodity Portfolio	Consensus Economics	08/1995-12/2022	0.66	7.23	0.09
Commodity Portfolio Extended	Consensus Economics	08/1995-12/2022	1.60	7.77	0.21

Table 3.2: Intermediary Financial Health and Subjective Risk Premia around the Financialization

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\hat{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. *Panel A* presents the results for the regressions in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.22	0.22	0.51	0.62	0.51	0.62
	[2.24]	[2.10]	[5.09]	[4.64]	[4.41]	[4.93]
$\tilde{\gamma}$ × DF			-0.30	-0.41	-0.71	-0.84
			[-2.07]	[-2.44]	[-2.41]	[-3.37]
DF			-0.78	-0.79	-2.37	-2.23
			[-3.96]	[-4.01]	[-12.49]	[-13.97]
$Adj.R^2$	0.05	0.05	0.14	0.14	0.89	0.91
N	167	167	167	167	42	42

Table 3.3: Non-Primary Dealers Financial Health and Subjective Risk Premia

This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\tilde{\gamma}$ (i.e. *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.34	0.37	0.06	0.12	0.06	0.13
	[2.84]	[3.03]	[0.98]	[1.38]	[0.96]	[1.37]
$\tilde{\gamma} \times$ DF			0.59	0.50	0.05	-0.10
			[2.66]	[2.23]	[0.36]	[-0.70]
DF			-0.55	-0.51	-2.21	-2.05
			[-2.49]	[-2.40]	[-9.81]	[-10.65]
$Adj.R^2$	0.12	0.14	0.23	0.22	0.83	0.82
N	167	167	167	167	42	42

Table 3.4: Heterogeneous Intermediaries and Subjective Risk Premia

This table reports results of predictive regressions of excess return expectations on the monthly proxy for heterogeneity among intermediaries (i.e. *intermheterog*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the measure of heterogeneity among intermediaries is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.37	0.40	0.26	0.29	0.26	0.29
	[1.82]	[2.02]	[5.67]	[4.81]	[4.32]	[4.32]
$\tilde{\gamma} \times$ DF			1.37	1.35	0.57	-0.42
			[4.34]	[4.51]	[0.93]	[-0.71]
DF			-0.89	-0.90	-2.11	-2.36
			[-4.83]	[-4.36]	[-6.00]	[-6.99]
Adj.R^2	0.05	0.06	0.32	0.33	0.87	0.86
N	167	167	167	167	42	42

Table 3.5: Intermediary Financial Health and Subjective Risk Premia for Non-Index Commodities
This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for a test asset containing non-index commodities. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A	*Panel B*	
	Full Sample	Full Sample	Up to the GFC
$\tilde{\gamma}$	0.24	0.41	0.41
	[1.97]	[1.21]	[1.27]
$\tilde{\gamma}$ × DF		-0.18	0.14
		[-0.5]	[0.36]
DF		-0.31	-1.49
		[-1.02]	[-5.28]
$Adj.R^2$	0.06	0.08	0.57
N	151	151	38

Table 3.6: Panel Tests - Forecasters' Subjective Risk Premia on the Average Intermediary Financial Health

This table reports the results of panel regressions of each forecaster's excess return expectations on the main proxy of intermediary risk aversion for both primary and *non*-primary dealers $\tilde{\gamma}$ (i.e., *icap* and *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the 12 commodities included in the *Portfolio Commodities Extended*. *Panel A* presents the results for the regressions on the financial health of the primary dealers. *Panel B* presents the results for the regressions on the financial health of the *non*-primary dealers. The panel regressions are in the following form: risk premia$^{\sigma}_{f,i,t+1} = b \times \tilde{\gamma}_t + c\,(\tilde{\gamma}_t \times DF_t) + d \times DF_t + \eta_f + \psi_i + \epsilon_{f,i,t+1}$, where the coefficients b, c and d are reported. Here, f represents the forecasters and i the commodities. All specifications include commodity and forecaster fixed effect. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics clustering by forecaster.

	Panel A			*Panel B*	
	Full Sample			Full Sample	
$\tilde{\gamma}$	0.15	0.29	$\tilde{\gamma}_{nonprim}$	0.27	0.07
	[10.80]	[6.35]		[15.09]	[6.64]
$\tilde{\gamma}$ × DF		-0.15	$\tilde{\gamma}_{nonprim}$ × DF		0.29
		[-3.14]			[9.71]
DF		-0.32	DF		-0.24
		[-4.70]			[-3.23]
$Adj.R^2$	0.02	0.03	$Adj.R^2$	0.04	0.06
N	29,619	29,619	N	29,619	29,619
Forecaster FE	Yes	Yes	Forecaster FE	Yes	Yes
Commodity FE	Yes	Yes	Commodity FE	Yes	Yes

Table 3.7: Separating Expectations: Intermediary Financial Health

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\hat{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk adverion measures. The subjective risk premia are for the test asset *Portfolio Commodities*, containing oil and four metals. However, the return expectations are divided over time into the expectations of the primary dealers and the expectations of all the professional forecasters except the primary dealers. The results are for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported.; and risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Expectations Primary Dealers			*Expectations Other Forecasters*		
	Full Sample		Up to GFC	Full Sample		Up to GFC
$\tilde{\gamma}$	0.27	0.49	0.49	0.16	0.48	0.48
	[2.77]	[4.81]	[3.93]	[1.50]	[4.56]	[4.41]
$\tilde{\gamma}$ × DF		-0.23	-0.57		-0.34	-0.86
		[-1.53]	[-2.01]		[-2.24]	[-2.43]
DF		-0.71	-2.23		-0.81	-2.48
		[-3.67]	[-12.05]		[-4.05]	[-11.94]
$Adj.R^2$	0.08	0.09	0.86	0.15	0.12	0.89
N	167	167	42	167	167	42

Table 3.8: Separating Expectations: Non-Primary Dealers Financial Health

This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\tilde{\gamma}$ (i.e. *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk adverion measures. The subjective risk premia are for the test asset *Portfolio Commodities*, containing oil and four metals. However, the return expectations are divided over time into the expectations of the primary dealers and the expectations of all the professional forecasters except the primary dealers. The results are for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported.; and risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Primary Dealers Expectations			*Expectations Other Forecasters*		
	Full Sample		Up to GFC	Full Sample		Up to GFC
$\tilde{\gamma}$	0.36	0.07	0.07	0.31	0.05	0.05
	[2.91]	[1.25]	[1.27]	[2.72]	[0.71]	[0.70]
$\tilde{\gamma}$ × DF		0.63	0.08		0.54	0.05
		[2.90]	[0.65]		[2.46]	[0.32]
DF		-0.47	-2.04		-0.60	-2.34
		[-2.20]	[-10.94]		[-2.65]	[-8.97]
Adj.R^2	0.13	0.25	0.81	0.10	0.21	0.83
N	167	167	42	167	167	42

3.9 Appendix

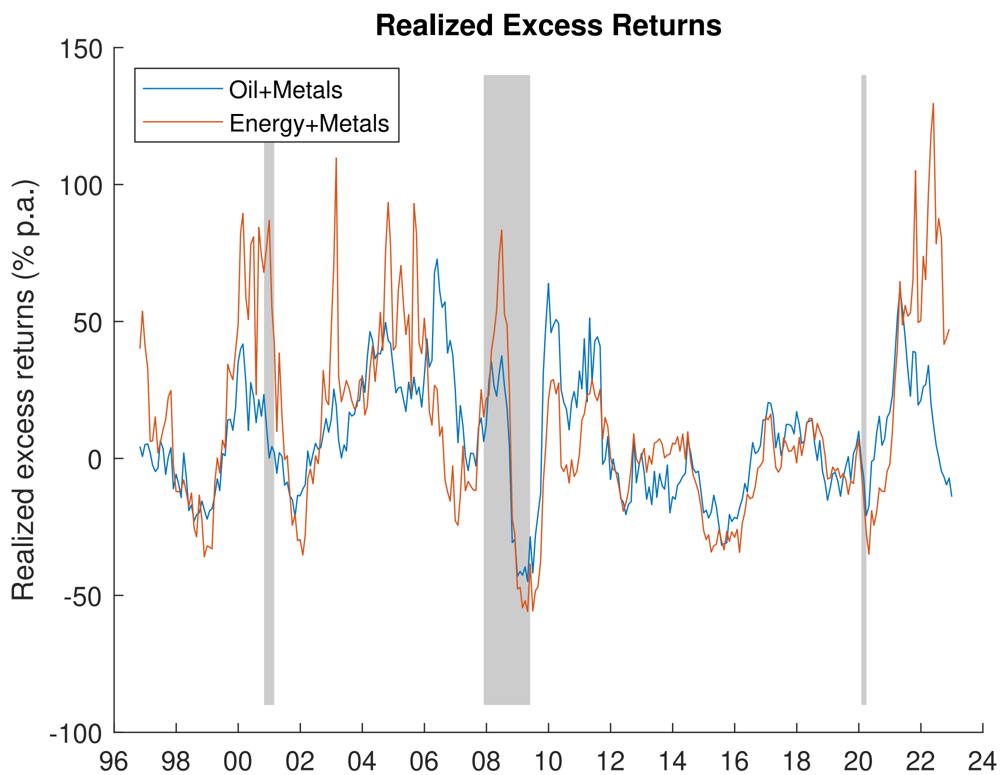

Figure 3.4: Realized Excess Returns

This figure plots the realized excess return of each portfolio of commodities, computed using (ex-post realization) data from Datastream (and Bloomberg). Grey-shaded areas indicate recessions. The realized returns are over the one-year horizon. Descriptive statistics are reported in Table 3.9.

Table 3.9: Descriptive Statistics of Commodity Realized Excess Returns

This table reports the one-year realized excess returns. I report the one-year excess returns on the two portfolios constructed. For each portfolio, the table reports the name, the source used to retrieve the data, the sample period, the mean (in %), the standard deviation (in %) and the sharpe ratio.

Portfolio	Source	Sample Period	$E[r_{t,t+1}]$	$\sigma(r_{t,t+1})$	$\frac{E[r_{t,t+1}]}{\sigma(r_{t,t+1})}$
Commodity Portfolio	Datastream and Bloomberg	08/1995-12/2022	7.06	21.78	0.32
Commodity Portfolio Extended	Datastream and Bloomberg	08/1995-12/2022	12.17	33.20	0.37

Table 3.10: Intermediary Financial Health and Subjective Risk Premia Across Subsamples

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*). The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$ and the coefficients $b_{i,j}$ are reported. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022, but the regressions are run over three different subsamples: i) pre-financialization (left panel), post-financialization (mid panel), post-Global Financial Crisis (right panel). The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Pre-Financialization		Post-Financialization		Post-GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.51	0.62	0.21	0.21	0.28	0.31
	[4.37]	[4.63]	[2.13]	[1.96]	[2.55]	[2.92]
$Adj.R^2$	0.39	0.53	0.05	0.05	0.11	0.13
N	29	29	138	138	115	115

Table 3.11: Intermediary Financial Health and Subjective Risk Premia, Using Median Subjective Returns

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. Subjective returns for each commodity are now computed taking the median, instead of the mean, across forecasters. *Panel A* presents the results for the regressions in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.19	0.20	0.51	0.63	0.51	0.63
	[1.87]	[1.83]	[4.49]	[4.34]	[4.38]	[5.12]
$\tilde{\gamma}$ × DF			-0.33	-0.45	-0.77	-0.84
			[-2.17]	[-2.48]	[-2.37]	[-3.07]
DF			-0.77	-0.76	-2.31	-2.18
			[-4.06]	[-3.74]	[-11.79]	[-12.86]
$Adj.R^2$	0.04	0.04	0.12	0.13	0.89	0.90
N	167	167	167	167	42	42

Table 3.12: Non-Primary Dealers Financial Health and Subjective Risk Premia, Using Median Subjective Returns
This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\tilde{\gamma}$ (i.e. *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. Subjective returns for each commodity are now computed taking the median, instead of the mean, across forecasters. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.32	0.35	0.05	0.12	0.05	0.12
	[2.67]	[2.86]	[0.72]	[1.27]	[0.71]	[1.29]
$\tilde{\gamma} \times$ DF			0.57	0.48	0.01	-0.14
			[2.60]	[2.04]	[0.04]	[-0.91]
DF			-0.55	-0.49	-2.18	-2.02
			[-2.54]	[-2.25]	[-9.33]	[-9.92]
Adj.R^2	0.10	0.12	0.21	0.20	0.82	0.80
N	167	167	167	167	42	42

Table 3.13: Non-Primary Dealers Financial Health and Subjective Risk Premia Across Subsamples
This table reports results of predictive regressions of excess return expectations on the monthly proxy of non-primary dealers risk aversion $\tilde{\gamma}$ (i.e. *icap-nonprim*). The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$ and the coefficients $b_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022, but the regressions are run over three different subsamples: i) pre-financialization (left panel), post-financialization (mid panel), post-global financial crisis (right panel). The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Pre-Financialization		Post-Financialization		Post-GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.06	0.12	0.65	0.63	0.64	0.69
	[0.92]	[1.35]	[3.11]	[3.18]	[3.31]	[3.64]
$Adj.R^2$	0.04	0.12	0.18	0.17	0.16	0.17
N	29	29	138	138	115	115

Table 3.14: Non-Primary Dealers Financial Health and Heterogeneous Intermediary, and Subjective Risk Premia (Excluding the Global Financial Crisis)

This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers (i.e. *icap-nonprim*) and on the proxy for heterogeneity in intermediaries (i.e. *intermheterog*). The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$; and the coefficients b_t, c_t and d_t are reported. Subjective risk premia are normalized by their full-sample volatility and the two intermediary effective risk aversion measures are standardized. The sample period is from 08/1995 to 12/2022, but excludes the years of the Global Financial Crisis. I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	icap-nonprim				*intermheterog*			
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.29	0.32	0.06	0.12	0.31	0.33	0.26	0.29
	[2.57]	[2.76]	[0.98]	[1.38]	[2.72]	[2.03]	[5.66]	[4.81]
$\tilde{\gamma} \times$ DF			0.51	0.44			1.31	1.20
			[2.05]	[1.75]			[3.64]	[4.05]
DF			-0.53	-0.46			-0.91	-0.88
			[-2.33]	[-2.11]			[-4.68]	[-4.12]
Adj.R^2	0.09	0.11	0.19	0.19	0.09	0.11	0.30	0.28
N	156	156	156	156	156	156	156	156

Table 3.15: Primary vs Non-Primary Dealers Financial Health, and Subjective Risk Premia

This table reports results of predictive regressions of excess return expectations on the monthly proxies of intermediary risk aversion computed for primary $\tilde{\gamma}$ (i.e., *icap*) and non-primary $\tilde{\gamma}_{nonprim}$ (i.e. *icap-nonprim*) dealers, on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_i + b_{i,1}\tilde{\gamma}_{1,t} + c_{i,1}(\tilde{\gamma}_{1,t} \times DF_t) + d_{i,2}\tilde{\gamma}_{2,t} + e_{i,2}(\tilde{\gamma}_{2,t} \times DF_t) + f_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t, d_t, e_t and f_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the two intermediary effective risk aversion measures are standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.13	0.12	0.51	0.58	0.51	0.58
	[1.26]	[1.10]	[5.00]	[4.22]	[4.44]	[4.65]
$\tilde{\gamma}$ × DF			-0.49	-0.56	-0.65	-0.80
			[-2.93]	[-3.07]	[-2.04]	[-3.20]
$\tilde{\gamma}_{nonprim}$	0.30	0.33	0.01	0.06	0.01	0.06
	[2.42]	[2.57]	[0.14]	[1.76]	[0.17]	[1.92]
$\tilde{\gamma}_{nonprim}$ × DF			0.62	0.55	0.08	-0.06
			[2.37]	[2.12]	[0.49]	[-0.34]
DF			-0.67	-0.65	-2.33	-2.19
			[-3.35]	[-3.43]	[-11.12]	[-11.29]
$Adj.R^2$	0.13	0.15	0.26	0.26	0.94	0.97
N	167	167	167	167	42	42

Table 3.16: Panel Tests - Forecasters' Subjective Risk Premia on Their Own Financial Health
This table reports the results of panel regressions of each forecaster's excess return expectations on its own financial health. The forecasters considered in the regression are a subset of the Consensus Economics data universe, mainly primary dealers, for which the corresponding financial health could be matched. The subjective risk premia are for the 12 commodities included in the *Portfolio Commodities Extended*. The panel regressions are in the following form: risk premia$^{\sigma}_{f,i,t+1} = b \times \tilde{\gamma}_{f,t} + \eta_f + \psi_i + \epsilon_{f,i,t+1}$, where the coefficient b is reported. Here, f represents the forecasters and i the commodities. All specifications include commodity and forecaster fixed effect. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. I compute test statistics clustering by forecaster.

	Full Sample
$\tilde{\gamma}_f$	0.17
	[3.53]
$Adj.R^2$	0.01
N	11,229
Forecaster FE	Yes
Commodity FE	Yes

Table 3.17: Primary Dealers Financial Health and Subjective Risk Premia around the Financialization (using a Continuous Financialization Variable)

This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\hat{\gamma}$ (i.e. *icap-nonprim*), on a continuous variable capturing the "financialization" $DFOI_t$, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DFOI_t) + d_{i,j}DFOI_t + e_{i,j}\hat{s}_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.54	0.64	0.44	0.56
	[3.61]	[5.25]	[3.24]	[3.98]
$\tilde{\gamma}$ × DFOI	-0.32	-0.43	-0.49	-0.58
	[-1.94]	[-3.12]	[-2.95]	[-3.53]
DFOI	-0.90	-0.89	-1.10	-1.07
	[-6.09]	[-7.39]	[-5.82]	[-9.95]
$Adj.R^2$	0.24	0.24	0.71	0.78
N	167	167	42	42

Table 3.18: Non-Primary Dealers Financial Health and Subjective Risk Premia around the Financialization (using a Continuous Financialization Variable)

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\hat{\gamma}$ (i.e. *icap*), on a continuous variable capturing the "financialization" $DFOI_t$, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DFOI_t) + d_{i,j}DFOI_t + e_{i,j}\hat{s}_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.09	0.16	0.09	0.14
	[1.29]	[1.56]	[1.42]	[1.61]
$\tilde{\gamma}$ × DFOI	0.35	0.28	-0.05	-0.13
	[2.04]	[1.54]	[-0.60]	[-1.38]
DFOI	-0.60	-0.58	-1.02	-0.99
	[-6.09]	[-7.39]	[-5.39]	[-7.14]
$Adj.R^2$	0.27	0.26	0.66	0.71
N	167	167	42	42

Table 3.19: Controlling for Changes in the Sensitivity of Primary Dealers to the Effective Risk Aversion Measure Around the Financialization

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\hat{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure $\tilde{\gamma}$ that captures potential changes in the sensitivity of primary dealers to the effective risk aversion measure. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}\hat{s}_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.88	0.97	0.58	0.69
	[5.86]	[5.27]	[3.75]	[4.23]
$\tilde{\gamma}$ × DF	-0.72	-0.81	-0.77	-0.90
	[-3.98]	[-3.86]	[-2.59]	[-3.55]
DF	-0.68	-0.69	-2.28	-2.15
	[-3.85]	[-3.70]	[-9.61]	[-11.13]
$\hat{s}$	-0.57	-0.54	-0.10	-0.10
	[-3.75]	[-3.23]	[-0.55]	[-0.67]
$Adj.R^2$	0.35	0.33	0.91	0.94
N	167	167	42	42

Table 3.20: Controlling for Changes in Hedging Pressure Around the Financialization
This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure hp_t that captures potential changes in hedging pressure. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}hp_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.51	0.64	0.49	0.61
	[5.05]	[4.74]	[3.85]	[4.74]
$\tilde{\gamma}$ × DF	-0.29	-0.44	-0.71	-0.83
	[-2.03]	[-2.56]	[-2.80]	[-3.30]
DF	-0.77	-0.78	-2.38	-2.24
	[-3.89]	[-3.98]	[-11.66]	[-13.93]
hp	-0.03	-0.47	-0.16	0.16
	[-0.97]	[-5.45]	[-1.63]	[1.61]
$Adj.R^2$	0.14	0.16	0.92	0.93
N	167	167	42	42

Table 3.21: Controlling for Changes in Hedging Pressure Around the Financialization - Non Primary Dealers Financial Health

This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\tilde{\gamma}$ (i.e. *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure hp_t that captures potential changes in hedging pressure. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}hp_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure are standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.06	0.13	0.05	0.12
	[0.94]	[1.49]	[0.77]	[1.27]
$\tilde{\gamma}$ × DF	0.61	0.49	0.07	-0.09
	[2.71]	[2.19]	[0.56]	[-0.65]
DF	-0.54	-0.49	-2.23	-2.07
	[-2.40]	[-2.37]	[-9.36]	[-10.51]
hp	-0.08	-0.45	-0.28	0.33
	[-1.83]	[-3.95]	[-2.89]	[2.65]
$Adj.R^2$	0.24	0.24	0.86	0.85
N	167	167	42	42

Table 3.22: Controlling for Changes in Open Interests Around the Financialization

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure oi_t that captures potential changes in open interests. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}oi_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.51	0.62	0.52	0.62
	[4.66]	[4.34]	[4.39]	[5.26]
$\tilde{\gamma}$ × DF	-0.38	-0.43	-0.65	-0.87
	[-2.16]	[-2.06]	[-2.26]	[-3.57]
DF	-0.77	-0.80	-2.65	-2.23
	[-3.61]	[-3.74]	[-9.67]	[-13.77]
oi	-0.21	-0.06	0.23	0.10
	[-1.27]	[-0.30]	[1.98]	[1.22]
$Adj.R^2$	0.17	0.15	0.93	0.94
N	167	167	42	42

Table 3.23: Controlling for Changes in Open Interests Around the Financialization - Non Primary Dealers Financial Health

This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\tilde{\gamma}$ (i.e. *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure oi_t that captures potential changes in open interests. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}oi_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.06	0.12	0.06	0.13
	[0.90]	[1.33]	[1.09]	[1.60]
$\tilde{\gamma}$ × DF	0.51	0.49	0.02	-0.16
	[2.03]	[2.02]	[0.13]	[-1.02]
DF	-0.56	-0.53	-2.47	-2.08
	[-2.43]	[-2.29]	[-8.56]	[-9.91]
oi	-0.14	-0.05	0.22	0.11
	[-0.94]	[-0.37]	[1.77]	[1.41]
$Adj.R^2$	0.25	0.23	0.86	0.85
N	167	167	42	42

Table 3.24: Controlling for Changes in Liquidity

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure liq_t that captures potential changes in market liquidity. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}liq_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.56	0.68	0.55	0.66
	[5.58]	[5.58]	[4.65]	[5.27]
$\tilde{\gamma}$ × DF	-0.34	-0.47	-0.72	-0.85
	[-2.53]	[-3.21]	[-2.52]	[-3.52]
DF	-0.77	-0.78	-2.39	-2.25
	[-4.01]	[-4.06]	[-12.96]	[-15.00]
liq	-0.10	-0.14	-0.08	-0.10
	[-1.56]	[-2.10]	[-2.81]	[-5.02]
Adj.R^2	0.15	0.16	0.92	0.95
N	167	163	42	42

Table 3.25: Controlling for Changes in Liquidity - Non Primary Dealers Financial Health
This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\tilde{\gamma}$ (i.e. *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure liq_t that captures potential changes in market liquidity. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}liq_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure are standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Up to the GFC			
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.06	0.12	0.06	0.12
	[0.98]	[1.36]	[0.96]	[1.37]
$\tilde{\gamma}$ × DF	0.58	0.50	0.05	-0.10
	[2.64]	[2.20]	[0.38]	[-0.68]
DF	-0.54	-0.50	-2.21	-2.06
	[-2.44]	[-2.29]	[-9.99]	[-10.86]
liq	-0.06	-0.09	-0.04	-0.05
	[-0.84]	[-1.29]	[-1.00]	[-1.36]
Adj.R^2	0.23	0.23	0.85	0.85
N	167	163	42	42

Table 3.26: Extrapolation from Past Expectations

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure $\tilde{E}[r_{i,t}]$ that captures past return expectations. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. *Panel A* presents the results for the regressions in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk $\text{premia}^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}\tilde{E}[r_{i,t}] + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.31	0.30	0.40	0.50	0.53	0.60
	[3.30]	[2.27]	[2.60]	[2.66]	[3.91]	[3.91]
$\tilde{\gamma}$ × DF			-0.10	-0.22	-0.80	-0.81
			[-0.53]	[-1.00]	[-1.85]	[-2.49]
DF			-0.62	-0.70	-2.46	-2.23
			[-3.03]	[-3.41]	[-10.56]	[-10.68]
$\tilde{E}[r_{i,t}]$	0.35	0.31	0.31	0.27	-0.05	0.01
	[3.03]	[2.04]	[2.55]	[2.00]	[-0.44]	[0.12]
$Adj.R^2$	0.17	0.14	0.22	0.21	0.92	0.95
N	163	163	163	163	38	38

Table 3.27: Extrapolation from Past Returns

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a measure $r_{i,t}$ that captures one-year past returns. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}r_{i,t} + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	-0.02	0.13	0.60	0.60	0.56	0.61
	[-0.30]	[1.42]	[4.22]	[5.62]	[5.84]	[5.63]
$\tilde{\gamma} \times$ DF			-0.67	-0.50	-1.06	-0.77
			[-4.17]	[-3.61]	[-3.12]	[-2.95]
DF			-0.51	-0.80	-1.76	-2.14
			[-3.37]	[-4.79]	[-7.37]	[-13.31]
$r_{i,t}$	-1.20	-0.47	-1.20	-0.48	-0.62	-0.15
	[-6.45]	[-3.86]	[-6.93]	[-4.40]	[-3.50]	[-2.71]
$Adj.R^2$	0.48	0.27	0.55	0.37	0.95	0.95
N	167	167	167	167	42	42

Table 3.28: Controlling for Business Cycle and Household Risk Aversion

This table reports results of predictive regressions of excess return expectations on the main proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *icap*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a set of controls for business cycle fluctuations and household risk aversion. These controls include: consumption growth, industrial production, and term spread. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \mu_i \times controls_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.11	0.10	0.40	0.46	0.45	0.51
	[0.82]	[0.70]	[2.47]	[2.54]	[3.19]	[3.91]
$\tilde{\gamma}$ × DF			-0.35	-0.43	-0.67	-0.65
			[-2.05]	[-2.29]	[-1.69]	[-2.16]
DF			-0.91	-0.92	-2.32	-2.20
			[-4.06]	[-4.38]	[-12.96]	[-12.85]
controls	✓	✓	✓	✓	✓	✓
Adj.R^2	0.08	0.09	0.20	0.21	0.97	0.99
N	167	167	167	167	42	42

Table 3.29: Controlling for Business Cycle and Household Risk Aversion - Non Primary Dealers Financial Health

This table reports results of predictive regressions of excess return expectations on the proxy for intermediary risk aversion computed only for non-primary dealers $\tilde{\gamma}$ (i.e. *icap-nonprim*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on a set of controls for business cycle fluctuations and household risk aversion. These controls include: consumption growth, industrial production, and term spread. The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.31	0.32	0.04	0.10	0.06	0.07
	[2.76]	[2.77]	[0.59]	[1.09]	[1.22]	[1.24]
$\tilde{\gamma}$ × DF			0.48	0.39	0.10	-0.15
			[1.91]	[1.64]	[0.55]	[-0.89]
DF			-0.69	-0.64	-2.11	-2.05
			[-2.67]	[-2.53]	[-10.15]	[-10.43]
controls	✓	✓	✓	✓	✓	✓
$Adj.R^2$	0.16	0.18	0.27	0.27	0.95	0.96
N	167	167	167	167	42	42

Table 3.30: Alternative Measure of Intermediary Financial Health and Subjective Risk Premia
This table reports results of predictive regressions of excess return expectations on the quarterly alternative proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *intermediaryra*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk adverion measures. *Panel A* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported. *Panel B* presents the results for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Panel A		*Panel B*			
	Full Sample		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.19	0.21	0.56	0.65	0.56	0.65
	[2.10]	[2.15]	[3.42]	[2.86]	[3.33]	[3.56]
$\tilde{\gamma}$ × DF			-0.39	-0.47	-0.88	-1.03
			[-1.96]	[-1.86]	[-2.37]	[-3.04]
DF			-1.01	-0.98	-2.36	-2.21
			[-3.36]	[-3.38]	[-11.21]	[-13.42]
Adj.R^2	0.03	0.04	0.22	0.23	0.86	0.87
N	79	79	79	79	42	42

Table 3.31: Alternative Measure of Intermediary Financial Health and Controls for Changes Around the Financialization
This table reports results of predictive regressions of excess return expectations on the quarterly alternative proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *intermediaryra*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on different control variables that might change around the financialization. The controls are the ones studied in Section 3.5, namely: a proxy for changes in the sensitivity of intermediaries to the effective risk aversion measure ($\hat{s}$), a proxy for hedging pressure (hp_t), and a proxy for open interest (oi_t). The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}hp_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. For space constraints, the table reports only the results for the analysis up to the global financial crisis, i.e. in the aftermath of the financialization. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	$\hat{s}$		hp		oi	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.53	0.56	0.52	0.63	0.59	0.66
	[1.90]	[2.22]	[3.07]	[3.37]	[3.13]	[3.80]
$\tilde{\gamma}$ × DF	-0.85	-0.96	-0.90	-1.01	-0.75	-1.06
	[-1.98]	[-2.70]	[-2.53]	[-2.95]	[-1.73]	[-2.93]
DF	-2.39	-2.29	-2.37	-2.22	-2.67	-2.22
	[-8.90]	[-9.49]	[-11.32]	[-13.37]	[-9.02]	[-13.16]
control	0.04	-0.10	-0.21	0.18	0.25	0.11
	[0.14]	[0.44]	[-2.09]	[1.49]	[2.03]	[1.36]
$Adj.R^2$	0.89	0.89	0.90	0.89	0.91	0.90
N	42	42	42	42	42	42

Table 3.32: Alternative Measure of Intermediary Financial Health and Extrapolation

This table reports results of predictive regressions of excess return expectations on the quarterly alternative proxy of intermediary risk aversion $\tilde{\gamma}$ (i.e. *intermediaryra*), on a dummy DF_t that takes value 1 after the financialization, on its interaction with the intermediary effective risk aversion measures, and on past expectations ($\tilde{E}[r_{i,t}]$) and past returns ($r_{i,t}$). The subjective risk premia are for the two test assets *Portfolio Commodities*, containing oil and four metals, and *Portfolio Commodities Extended*, containing energy and metals. The regressions are in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + e_{i,j}hp_t + \epsilon_{i,t+1}$; and the coefficients $b_{i,j}$, $c_{i,j}$, $d_{i,j}$ and $e_{i,j}$ are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the intermediary effective risk aversion measure is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	$\tilde{E}[r_{i,t}]$				$r_{i,t}$			
	Full Sample		Up to the GFC		Full Sample		Up to the GFC	
	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals	Oil+Metals	Energy+Metals
$\tilde{\gamma}$	0.36	0.45	0.56	0.60	0.74	0.69	0.64	0.66
	[1.56]	[1.62]	[2.81]	[2.85]	[4.44]	[3.95]	[4.35]	[4.06]
$\tilde{\gamma} \times$ DF	-0.14	-0.24	-0.96	-0.94	-0.81	-0.57	-1.33	-0.91
	[-0.52]	[-0.75]	[-1.67]	[-2.05]	[-4.35]	[-2.86]	[-2.86]	[-2.58]
DF	-0.81	-0.90	-2.45	-2.23	-0.61	-0.96	-1.76	-2.12
	[-2.74]	[-3.10]	[-9.99]	[-10.11]	[-3.07]	[-4.01]	[-7.19]	[-12.92]
extrapolation	0.33	0.27	-0.04	0.02	-1.37	-0.48	-0.62	-0.17
	[2.52]	[1.77]	[-0.37]	[0.19]	[-7.05]	[-3.76]	[-3.14]	[-3.16]
$Adj.R^2$	0.32	0.30	0.90	0.91	0.66	0.43	0.93	0.92
N	75	75	38	38	79	79	42	42

Table 3.33: Distinguishing Expectations: Heterogeneous Intermediaries

This table reports results of predictive regressions of excess return expectations on the monthly proxy for heterogeneity among intermediaries (i.e. *intermheterog*), on a dummy DF_t that takes value 1 after the financialization, and on its interaction with the intermediary effective risk aversion measures. The subjective risk premia are for the test asset *Portfolio Commodities*, containing oil and four metals. However, the return expectations are divided over time into the expectations of the primary dealers and the expectations of all the professional forecasters except the primary dealers. The results are for the regressions in the following form: risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + \epsilon_{i,t+1}$, where the coefficients $b_{i,j}$ are reported.; and risk premia$^{\sigma}_{i,t+1} = a_{i,j} + b_{i,j}\tilde{\gamma}_{j,t} + c_{i,j}(\tilde{\gamma}_{j,t} \times DF_t) + d_{i,j}DF_t + \epsilon_{i,t+1}$, where the coefficients b_t, c_t and d_t are reported. "GFC" stands for Global Financial Crisis. Subjective risk premia are normalized by their full-sample volatility and the measure of heterogeneity among intermediaries is standardized. The sample period is from 08/1995 to 12/2022. The choice of 2004 as date for the financialization of commodity markets is driven by the previous literature (see Basak and Pavlova (2016) and Brogaard, Ringgenberg, and Sovich (2019), among others). I compute test statistics using Newey and West (1987) corrected standard errors (with lag selection following Andrews (1991)).

	Expectations Primary Dealers			*Expectations Other Forecasters*		
	Full Sample		Up to GFC	Full Sample		Up to GFC
$\tilde{\gamma}$	0.40	0.28	0.28	0.33	0.22	0.22
	[1.96]	[5.78]	[4.44]	[1.64]	[4.16]	[3.63]
$\tilde{\gamma}$ × DF		1.35	0.81		1.37	0.39
		[4.81]	[1.60]		[3.95]	[0.55]
DF		-0.85	-1.88		-0.90	-2.30
		[4.64]	[-7.03]		[-4.86]	[-5.28]
$Adj.R^2$	0.06	0.32	0.87	0.04	0.32	0.86
N	167	167	42	167	167	42

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