Commodity Risk Premiums Everywhere

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Abstract

Using data on 230 commodity futures contracts traded between 1871 and 2025, we document pervasive and persistent commodity risk premiums. Nearly three quarters of contracts earn positive lifetime arithmetic excess returns, and 60% generate positive lifetime geometric excess returns. The median contract earns 5.16% per annum. The premium is robust across sectors, geographies and time periods. Portfolio returns closely match contract-level medians, indicating that expected returns originate at the contract level. In contrast to the prior literature, we document that commodity futures are positively correlated with equities – 0.3 over a 155-year history. Equity market exposure varies across macroeconomic regimes and explains roughly one third of the average premium, leaving a sizeable unexplained fraction. A decomposition of the premium into spot returns and interest-adjusted carry reveals a systematic market exposure and an orthogonal component of the risk premium; the systematic exposure operates entirely through spot returns while carry remains largely orthogonal to equity risk.

Keywords: commodity futures, risk premium, carry, time varying betas, long-term returns.

JEL codes: G12, G13, G15

1. Introduction

This paper studies two longstanding questions that are central to the literature on the pricing of commodity futures. First, to what extent do commodity futures prices embed a risk premium? Second, is there a systematic component to the risk premium or is it compensation for idiosyncratic commodity market risk?

The intellectual foundation for a risk premium dates back to Keynes (1923), who argues that futures prices should embed a discount relative to expected spot prices to compensate speculators for bearing price risk transferred by hedgers. Yet early empirical studies reach mixed conclusions. Working (1949), Telser (1958), and Gray (1961) question whether the data support a systematic premium. Modern evidence based on post-1960 data generally finds positive excess returns to long diversified commodity futures portfolios (Bodie and Rosansky (1980); Fama and French (1987), Gorton and Rouwenhorst (2006)), but two concerns remain. First, Erb and Harvey (2006) argue that portfolio returns may reflect mechanical rebalancing effects rather than compensation earned at the contract level. Second, a related literature examines whether the rapid growth of index investment after 2004, termed financialization, has compressed risk premiums (Hamilton and Wu (2014), Bhardwaj et al (2016), Irwin and Sanders (2012), Carter and Revoredo-Ghia (2023)).

On the second question, the consensus in the literature has generally been that commodity prices fluctuate largely independently from equity markets. Dusak (1973), Bodie and Rosansky (1980), Carter et al (1983), and Gorton and Rouwenhorst (2006) all report commodity-equity correlations that are close to zero or even negative, indicating that positive returns to long positions in commodity futures cannot be explained by "systematic" exposure to stock market risk. While Tang and Xiong (2012) document that correlations have increased after the financialization of commodity markets, no study has systematically examined the link between the risk premium on commodity futures and equity market risk factors. More broadly, conclusions about commodity risk premiums and their relation to equity markets have relied on relatively short samples, raising the possibility that estimates are sensitive to particular historical episodes.

We assemble a comprehensive database of 230 commodity futures contracts traded on 36 exchanges between 1871 and 2025 to revisit both the existence of the commodity risk premium and its integration with broader capital markets over a 155-year horizon. The length and breadth of the data allow us to test whether positive excess returns are pervasive at the contract level, whether portfolio-level returns reflect genuine expected compensation rather than rebalancing mechanics, and examine the extent to which commodity futures risk premiums reflect systematic compensation for exposure to equity markets across distinct macroeconomic regimes.

We document two sets of results. First, the commodity risk premium is prevalent at the contract level. The median futures contract earns an arithmetic excess return of 5.16% per annum, and nearly three quarters of contracts earn positive lifetime arithmetic excess returns. This pattern holds across sectors, exchanges in North America, Europe, and Asia, renewable and non-renewable commodities, and US and non-US traded contracts. A majority of contracts (60%) also earn positive geometric excess returns over their lifetimes. In contrast to evidence for equities, where lifetime returns are concentrated in a minority of stocks (43%, Bessembinder (2018)), positive long-run performance in commodities is broadly distributed across contracts. The evidence indicates that the premium is not confined to a particular sector, geography, or era, but is a persistent feature of commodity futures markets.

Portfolio formation reinforces the contract level evidence and enhances statistical power but does not mechanically generate the premium. An equally-weighted index of all available contracts earns an annualized excess return of 5.46% over the full sample, significant in each of the three major subperiods we examine. The portfolio's arithmetic mean closely matches the median contract-level premium, indicating that expected returns originate at the contract level. Although the portfolio's geometric growth rate exceeds that of the typical contract due to variance reduction from low cross-contract correlations, this diversification return affects compounding rather than expected return. The evidence therefore addresses the critique of Erb and Harvey (2006): while diversification enhances long-run wealth accumulation, the underlying risk premium does not depend on rebalancing.

Our second set of results shows that over long horizons, commodity futures have been positively correlated with equity markets. Over the full 1871–2025 period, the equal-weighted commodity index exhibits a positive and economically meaningful exposure to equity market risk. Equity market exposure explain one third of the unconditional commodity premium, and up to half in sub-periods. At the same time, equity exposure does not fully account for average returns, particularly during the 1960–2004 period, when estimated betas are small and intercepts remain economically significant. The literature reporting low or negative commodity-equity correlations relies on samples that overlap with the 1960-2004 period which our long-term data shows was anomalous from a historical perspective. Therefore, the degree of segmentation between commodity and equity markets may be overstated when conclusions are based on shorter samples. Allowing betas to vary with inflation regimes and the business cycle reconciles some of the time variation in market exposure, but a residual premium remains.

A decomposition of futures returns further isolates the common component and the residual component of commodity price risk. When we decompose the returns into spot price appreciation and interest-adjusted carry we find that both components contribute equally to the risk premium. However, the systematic equity exposure is entirely concentrated in spot returns, whereas carry is largely orthogonal to equity market risk. Carry embeds the average convenience yield, which under the theory of storage reflects a compensation for the idiosyncratic stockout risk in individual commodities. The unexplained portion of the premium is therefore primarily associated with commodity-specific risks. These results suggest that commodity futures have historically compensated investors for bearing risks that are partly shared with equities and partly distinct.

Taken together, our findings indicate that commodity futures have delivered persistent and economically meaningful compensation for investors over more than a century and a half. The premium is observable at both the contract and portfolio levels, survives the financialization of commodity markets, and reflects both macroeconomic risk that is correlated with equity markets and an orthogonal commodity-specific component. By documenting the prevalence, persistence, and partial integration of commodity risk premiums over 155 years, this study provides new evidence on the role of commodities within the broader structure of capital markets.

The remainder of the paper proceeds as follows. Section 2 defines the commodity risk premium and describes the data. Section 3 documents contract-level evidence. Section 4 analyzes portfolio average excess returns. Section 5 studies whether equity exposure can explain the commodity risk premium and provides the risk premium decomposition. Section 6 concludes.

2. The commodity risk premium: definition and data

The risk premium on a futures contract maturing at time T is defined as the discount of the futures price at time t relative to the expected spot price at expiration, $(E(S_T) - F_t^T)/F_t^T$, and captures the expected rate of appreciation of the futures price until contract expiry. Because spot prices at expiration are often unavailable or measured with error, we follow standard practice in the empirical literature and estimate the futures risk premium as the sample average of the appreciation of the nearest-to-maturity contract that does not expire in the current month:

$$R_{t,t+1}^T = \frac{F_{t+1}^T - F_t^T}{F_t^T} \qquad (1)$$

Using consecutive month-end prices on the same contract implicitly assumes that contracts are rolled at the end of each expiration month, ensuring that each monthly return observation reflects a pure price change on a single contract rather than a blend of price and roll returns. The arithmetic mean of the monthly excess return series is an unbiased estimator of the expected single-period return — which is the relevant measure of the premium that investors earn per period for bearing commodity price risk. We also report geometric mean returns, to determine how individual contracts and commodity portfolios contribute to long-term wealth accumulation.

2.1 Data

The database consists of prices for 230 commodity futures contracts listed on 36 exchanges going back to 1871 and ending in 2025. Of these 230 contracts, 48 are currently surviving, while 182 are defunct. The primary sources of futures price data are the yearbooks published by the Chicago Board of Trade (CBOT), the Chicago Mercantile Exchange (CME), and the Annual Report of the Chamber of Commerce of Minneapolis (CCM). Newspaper data were collected from The New York Times, the Wall Street Journal and the Chicago Tribune in the United States and The Guardian in the United Kingdom. In the final sample, exchange yearbooks account for 37 contracts, newspapers 184, and the rest come from standard databases. For price data obtained from newspapers, we used two independent sources to verify the accuracy of prices when possible. Internet Appendix A1 contains a detailed description of the data, Internet Appendix Table A1 includes contract-level data sources, and Internet Appendix Figure A1 displays the chronological evolution of each contract organized by sectors.

3. Empirical evidence on contract level risk premiums

Can the commodity risk premium be detected using individual contract level prices? Is the premium different for currently active contracts than for contracts that failed to survive? Is it concentrated in certain sectors, or does the premium vary by geography or commodity characteristics such as renewability? Answering these questions helps to place the existing literature in perspective.

Studies examining individual commodity futures contracts have generally been inconclusive on the question of whether a risk premium exists. Early studies examined a small number of agricultural contracts and reached mixed conclusions (Working, 1949; Houthakker, 1957; Telser, 1958; Cootner, 1960; Gray, 1961). In broader samples, Bodie and Rosansky (1980) and Fama and French (1987) report premiums that are generally positive but lack the statistical power to reject the null of a zero premium at the contract level due to high price volatility combined with relatively short time-series of 27 and 19 years respectively. Kolb (1992) examines 29 surviving contracts over 30 years and finds little support for normal backwardation. More recently, Gorton and Rouwenhorst (2006) document predominantly positive premiums across 36 commodities over 45 years, while Erb and Harvey (2006) report geometric average excess returns in a 22-year sample of 12 commodities included in commercial index benchmarks. Little evidence exists about premiums in non-US markets, or whether premiums vary across sectors or differ between renewable and non-renewable commodities. The evidence for a positive premium is stronger at the portfolio level (Bodie and Rosansky (1980), Gorton and Rouwenhorst (2006), Levine, Ooi, Richardson, Sasseville (2018), Geczy and Samonov (2019)), but it has been questioned whether these excess returns reflect a genuine contract-level risk premium or are attributable instead to the tailwind of rebalancing a portfolio of volatile, low-correlation assets (Erb and Harvey (2006), Willenbrock (2011)). Our 155-year sample covering 230 contracts presents an opportunity to address the lack of statistical power in short samples, and the selection issues related to focusing on a small subset and potentially unrepresentative subset of available contracts.

3.1 Arithmetic average excess returns and survival since 1871

We calculate arithmetic average excess returns for all 230 contracts in the sample, using all available monthly observations. Table 1 summarizes the means and medians of the distribution of risk premiums by survival status and commodity characteristics.

Panel A shows that mean estimated risk premium across all futures was 2.59% annualized, compared to 5.16% for the median contract. Three quarters (73%) of the contracts earn a positive premium. Using a simple binomial test under the null hypothesis that population risk premiums are equally likely to be positive or negative, the probability of observing 73% or more positive premiums is less than 1%.

The distribution of means depends on survival. The premium is higher and more prevalent among long-lived contracts, defined as futures with histories that exceed 10 years. Across this subset (N=131) the mean (median) premium is 6.25% (5.75%), with seven out of every eight (87%) contracts reporting a positive risk premium. For currently surviving contracts (N=47) the mean is 5.87% annualized (median 6.01%), of which more than nine of every 10 (93.6%) record positive life-time risk premium as of December 2025.

The last row illustrates the survivorship bias: the premiums are lower for non-surviving contracts (mean = 1.75%, median = 4.75%) compared to surviving contracts. Janardanan et al. (2025) show that a low premium negatively predicts the probability of survival of a futures contract. In Internet Appendix Table A2 we show that excluding short lived contracts (< 1 year) substantially increases the full sample means, with modest impact on the medians. Because the premiums are also imprecisely estimated for short-term contracts, we will focus on the medians. The conclusion from Panel A is that positive premiums are prevalent overall and more so among long-lived and currently surviving contracts.

3.2 Geometric average returns

Geometric average returns measure wealth accumulation over time, and do not directly speak to the prevalence of risk premiums. By construction arithmetic averages exceed geometric averages by one half the variance. The mean and median geometric averages are positive, and slightly higher for long-lived and currently surviving contracts. The same pattern is reflected in the fraction of contracts with positive geometric means, which is higher for long-lived contracts (67.9%) or among currently surviving contracts (78.7%).

To put the 60% fraction of commodities earning a positive geometric mean into broader perspective, a comparison to equities is instructive. Bessembinder (2018) provides a comprehensive study that benchmarks the compound return to individual stocks against Treasury bills. In a sample that starts in 1926, he reports that across US stocks the median geometric average return is lower than T-bills, and that on a matched basis only 42.6% of stocks beat T-bills over the past 100 years. By this measure an investment in commodity futures more consistently contributes to wealth accumulation than US stocks. While a more detailed analysis is beyond the scope of this paper, we can conclude that in comparison with similarly volatile assets, our finding that 60% of the geometric means are positive is a relatively high number and surprising from a skeptical perspective of commodity risk premiums.

3.3 Characteristics: sectors, renewability, foreign markets

Panel B of Table 1 groups contracts by sector. Two sectors stand out. First, the median for the energy sector is more than double (12.43%) the full sample median. This possibly reflects the stockout risk and associated price volatility of this sector. Second, industrial metals has the highest fraction of contracts with positive risk premiums (94.7%). Contributing to this is the fact that many contracts in this sector are long-lived. As a group, the premiums among non-renewables (most energies, and metals) exceed those for renewables (Panel C). This pattern is broadly consistent with the Theory of Storage (Deaton and Laroque (1992), Gorton et al. (2013)) which predicts that risk premiums are a function of the risk of a stock-out. At short horizons, this depends on inventory levels; more structurally it depends on storability, the cost of storage and the elasticity of production in response to shocks to demand and supply. These factors are likely to vary across commodities: The production of industrial metals is inelastic compared to many agricultural crops which can be replanted annually. Energy commodities such as crude oil and natural gas are expensive to store above ground compared to many softs.

The literature on premiums in international markets is very sparse. Most recent studies have focused on China, but the relatively short history of Chinese futures markets complicates the reliable measurement of risk premiums (He, Jiang and Molyboga (2019)). We know of no systematic study of risk premiums in the UK which has a long history of futures trading. Our sample has more than 20 contracts from UK markets (London, Liverpool, and Manchester) with the earliest going back to 1875 (London Copper and Tin contracts).

Table 1C shows that the median contract level risk premium is nearly identical for US versus non-US contracts (5.16% versus 5.18%). The fraction of contracts with positive premiums exceeds 70% in both subgroups and is slightly higher among non-US contracts. These results suggest that premiums are not unique to US markets but also characteristic of price setting in commodity futures markets elsewhere in the world

Finally, Panel C shows that contracts listed in major financial centers (Chicago, New York, London) carry higher premiums than other locations. Janardanan et al. (2025) show that, consistent with the higher risk premiums, contracts on large exchanges had lower failure rates. The premium difference could be a contributing factor driving the historical consolidation of futures trading on large exchanges, and the demise of smaller exchanges with unsuccessful contracts.

3.4 Sub-period results

We divide the 1871-2025 sample into three sub-periods with breakpoints at the end of 1959 and 2004. The breakpoints were chosen to bracket the sample period in Gorton and Rouwenhorst (2006), who used the CRB database 1959-2004. The period post-2004 is often associated with the "financialization" of commodity markets. In an appendix table, we also provide results when we split the full sample in periods of approximately equal length.

Panel D of Table 1 shows that the median premium is positive in all three sub-samples, and ranges from 3.14% (1960-2004) to 6.92% (2005-2025). Interestingly, the median premium is highest during the financialization period, as is the fraction positive premiums (79.6%). Many of the short-lived and low premium contracts fall in the 1960 period, suppressing the contract means relative to the median in the early sub-sample. The conclusion of this section is that the premium is not confined to the 1960-2004 sample period. In fact, the median and the fraction of positive premiums are the lowest during this period, when compared to the two other sub-sample periods. We conclude that positive contract level risk premiums have been consistently present in all three subperiods, though the magnitude varies.

4. Portfolio risk premiums

Despite the prevalence of positive premiums, relatively few pass the test of statistical significance. Only 20% (46/230) of the mean excess returns in full sample have a *t*-statistic that exceeds 2. The combination of short return histories and high price volatility contributes to low statistical power to reliably detect premiums. In this section we construct portfolios to address this power problem. Portfolios can be formed over long horizons and benefit from diversification – both features enhance the power to detect premiums. In addition to an equally-weighted portfolio of all contracts, we form portfolios by sector and commodity characteristics. Because we form equally-weighted portfolios, we expect the individual contract results reported in Section 3 to largely carry over into portfolio returns.

4.1 EW commodity portfolio and subsector results

Panel A of Table 2 shows that the full sample risk premium on the EW commodity portfolio is 5.46% (t=4.80) since 1871. Portfolios of long-lived contracts as well as currently surviving contracts have earned substantially the same returns. Note further that these premiums are close to the median contract premium of 5.16% reported in Table 1. With the exception of the energy sector, which earned a premium of 10.7%, the excess return on sector portfolios falls in a narrow range between 4.24% and 5.79%. The energy sector has a much shorter return history, but as can be seen from Figure 2, the sector has outperformed all other sectors since its launch in 1978[1]. Both portfolios of non-renewables as well as foreign contracts have earned marginally higher returns than average, but the differences with the EW commodities portfolio are not significant over a 150-year period.

The sub-period analysis in Panel D shows that risk premiums have not only been stable across sectors, but also across sub-samples. Consistent with the contract level results, the equally-weighted portfolio earned its lowest premium in the 1960-2004 period (4.74%), and the highest premium in the post financialization period between 2005-2025 (6.23%). The pre-1960 premium of 5.65% is consistent with the findings of Levine et al. (2018) who tracked an index of six commodities over an overlapping period. Risk premiums are significantly different from zero in each subperiod, and an F-test cannot reject the hypothesis of equality of means across subperiods (p = 0.91).

4.2 Rebalancing frequency

[1] Gasoline and crude oil contracts did trade between 1935 and 1936, but these differ significantly from the modern energy contracts introduced in the late 1970s.

Willenbrock (2011) questions whether frequent rebalancing inflates commodity index returns by embedding a profitable trading strategy. Panel E of Table 2 tests this concern by comparing portfolio arithmetic means across rebalancing frequencies ranging from three months to five years. Contrary to Willenbrock's hypothesis, we find that monthly rebalancing yields the lowest arithmetic mean (5.46%), while less frequent rebalancing produces higher returns (quarterly: 5.71%, annual: 5.85%, five-year: 5.92%). We interpret the premium on our monthly rebalanced index as a conservative estimate of the risk premium.

4.3 Geometric returns and index diversification

Erb and Harvey (2006) argue that equal-weighted commodity index returns are inflated by a "diversification return" that does not represent a risk premium. This critique conflates risk premiums with wealth accumulation. Risk premiums are measured by arithmetic mean excess returns (the expected per-period return), whereas wealth accumulation is measured by geometric mean returns (the compound growth rate). The diversification return affects geometric means, not arithmetic means.

The portfolio arithmetic mean of 5.46% closely matches the median contract premium of 5.16% (Table 1), confirming that risk premiums carry over from individual contracts to the portfolio. However, the portfolio geometric mean of 4.56% substantially exceeds the median contract geometric mean of 1.48%. This gap reflects the diversification return (Booth and Fama (1992)): the portfolio's lower volatility, due to low average correlations among commodity contracts, reduces the variance drag on compounding and results in higher wealth accumulation over time. Importantly, this diversification return supplements but does not substitute for the underlying contract-level risk premiums established in Table 1. Commodity futures portfolios benefit from both positive arithmetic means (risk premiums) and low correlations (diversification).

4.4 Correlations with equities

The last column of Table 2 lists correlation of commodities with stocks. The full sample correlation of the EW index is 0.29 and positive for all sectors. It varies in sub-samples from a low of 5.2% during the 1960-2004 period to 46.6% in the most recent 20-year period. These estimates are in sharp contrast with the commonly held view in the literature that commodities have low (or negative) correlation with equities (Dusak (1973), Bodie and Rosansky (1980), Gorton and

Rouwenhorst (2006)). More recent papers have discussed that the correlation may have increased post 2004 due to the financialization of commodity markets (Tang and Xiong (2012), Bhardwaj et al. (2016)). Reflecting the commonly held view, some papers have proposed pricing models for commodity futures markets that omit stock market benchmarks altogether (Bakshi, et al. (2019)). The correlations in Table 2 suggest that commodity futures markets have had significant positive exposure to equities over long horizons, which may in part account for the documented risk premium. We explore this issue further in Section 5.

In summary, portfolio formation enhances statistical power: while only 20% of individual contracts have statistically significant premiums at the 5% level, the equal-weighted commodity portfolio earns a risk premium of 5.46% with a t-statistic of 4.80 ($p < 0.001$). The EW portfolio's geometric mean of 4.56% per annum reflects both this risk premium and the diversification benefits of combining low-correlation assets. These portfolio-level results are robust to sector composition, subperiod selection, and rebalancing frequency.

5. Does equity market risk explain the commodity risk premium?

Commodity futures have earned positive average excess returns over the past 155 years. Much of the literature explains this premium using mechanisms specific to commodity markets, such as the Theory of Normal Backwardation (Keynes (1923)) and the Theory of Storage (Deaton and Laroque (1992)). Earlier empirical work also examined whether commodity futures earn a premium as compensation for systematic equity market risk. Using postwar samples, Dusak (1973) and Bodie and Rosansky (1980) find little evidence of priced stock market exposure. Hirshleifer (1988) provides a useful theoretical bridge, showing that the commodity risk premium may contain both a systematic market component and a distinct residual component.

Motivated by these strands of the literature, we quantify the extent to which equity market risk explains the commodity risk premium over a 155-year sample. Commodity futures exhibit economically meaningful equity betas, and exposure to equity risk accounts for roughly one third of the average excess return. However, the remaining two thirds of the premium are not explained by standard equity factors and remain economically and statistically significant. Allowing equity betas to vary with macroeconomic conditions helps explain why commodity–equity correlations appear unusually weak in certain historical episodes, but does little to account for the magnitude of the premium. A decomposition of returns into spot price appreciation and interest-adjusted carry reveals that systematic equity exposure is entirely concentrated in spot returns, whereas carry is largely orthogonal to equity market risk. The unexplained portion of the premium is therefore primarily associated with commodity-specific risks.

5.1 Baseline evidence

We begin by regressing the excess return of the equally-weighted commodity index on equity market benchmarks. Table 3, Panel A reports that the full-sample market beta is 0.25 (t = 12.9). The corresponding intercept is 3.70% per annum (t = 3.4), compared to a mean excess return of 5.37% since 1871. Exposure to equity market risk therefore explains roughly one third of the long-run commodity premium. The remaining intercept is economically large, indicating that systematic equity exposure alone cannot account for the level of the premium.

Expanding the benchmark to include the Fama–French three factors and the Carhart momentum factor increases explanatory power (Panel B). Since 1926, commodity futures exhibit significant exposure to SMB and HML, but not to momentum. Accounting for these additional factors reduces the intercept to 2.71% (t = 2.2), which remains statistically significant at the 5% level. Panel C further tests whether average excess returns on the equally-weighted portfolio can be explained by the 13 theme factors of Jensen et al. (2023). The intercept remains statistically significant and economically large, ranging from 3.35% to 6.31% per annum. Thus, even in a multi-factor framework, a sizable residual premium persists.

Sector-level results broadly resemble those of the aggregate index but are noisier. With the exception of energy, all sectors display significant market betas at conventional levels. Industrial metals have the highest beta, consistent with their sensitivity to the business cycle, while precious metals and energy have the lowest. Although risk-adjusted returns are positive across sectors, they are not always statistically significant, particularly for precious metals and animal products, reflecting higher volatility. The energy sector is notable for combining a low beta of 0.15 with the highest raw excess return, 10.7% per annum. Because energy contracts were introduced only in 1978, the available sample is shorter.

Overall, the baseline evidence indicates that equity market risk is economically relevant for commodity futures, but it does not fully explain the average excess return.

5.2 Sub-period stability

To reconcile our findings with earlier studies that documented weak commodity–equity correlations, we examine subperiod behavior. The results reveal substantial heterogeneity across historical episodes.

In the pre-1960 and post-2004 periods, equity betas are 0.34 (t = 12.3) and 0.39 (t = 8.3), respectively. In these periods, equity exposure explains a large share of the premium. Accounting for equity exposure renders the pre-1960 and post-2004 intercepts statistically indistinguishable from zero.

The 1960–2004 period stands in sharp contrast. The estimated equity beta falls to 0.04 and is not statistically different from zero (t = 1.23). As a result, the risk-adjusted return of 4.52% is close to the raw excess return of 4.74%, and the null of a zero intercept is rejected at the 95% level (t = 2.8). Excluding energy contracts does not alter this conclusion. Between 1960 and 2004, the EW index excluding energy has a similarly low market exposure (0.06 versus 0.04 when energy is included) and an economically significant alpha of 3.27% (t = 2.0).

These findings overturn the view that commodity–equity comovement has historically been negligible. The commonly held view is that the equity-commodity correlation has been low historically but has increased recently during the "financialization" of markets. The long-run evidence shows that commodity–equity correlations have been positive for most of the past 155 years, with 1960–2004 representing an unusually weak episode rather than the historical norm. The prior literature's documentation of near-zero or negative commodity-equity correlations rests on shorter samples drawn from this episode.

5.3 State dependence: Time-varying betas

The 1960–2004 subsample includes two oil crises associated with commodity-induced recessions and high inflation. These stagflation episodes provide a natural candidate explanation for the collapse in equity betas.

We model time variation in equity exposure using indicator variables for the business cycle and inflation regime. We estimate the following model:

$$R^e_{c,t} = \alpha_0 + (\beta_0 + \beta_1 D_t + \beta_2 \pi_t + \beta_3 D_t \pi_t) R^e_{m,t} + \varepsilon_t \qquad (2)$$

where $R^e_{m,t}$ is the excess return on the value-weight stock market return and $R^e_{c,t}$ is the excess return of a commodity portfolio. D_t equals one in NBER-defined recessions and π_t equals one when year-over-year inflation exceeds zero.

Panel D of Table 3 shows that betas increase by 0.11 ($t = 2.1$) in recessions relative to the baseline expansion beta of 0.24. The high-inflation indicator alone is not statistically significant. However, the interaction between inflation and recessions reduces the beta by 0.21 ($t = -2.5$). Thus, it is not inflation *per se*, but high inflation during economic contractions, that compresses commodities' systematic market exposure. During stagflationary recessions, commodity prices often rise while equity markets decline, reducing the correlation between the two asset classes.

Allowing for time-varying betas helps explain the low measured equity exposure during 1960–2004. Nevertheless, even after accounting for macroeconomic state dependence, a large fraction of the commodity premium remains unexplained. Two thirds of the full-sample premium—and essentially the entire premium during 1960–2004—cannot be attributed to equity market risk, even after allowing for time-varying exposures.

5.4 A decomposition of the commodity futures risk premium

To better understand the source of systematic exposure, we decompose the excess futures return into an excess spot return, interest-adjusted carry, and a residual term reflecting the cross-product between spot and carry (Levine et al. (2018)):

$$R^T_{t,t+1} = R^{e,S}_{t,t+1} + \psi_{t,t+1} + \eta_{t,t+1} \qquad (3)$$

where $R^{e,S}_{t,t+1}$ is the excess spot return, $\psi_{t,t+1}$ the interest-adjusted carry, and $\eta_{t,t+1}$ the residual. The excess spot return measures the rate of change in spot prices above the risk-free rate. The carry component captures the slope of the futures curve, adjusted for interest rates. Under the Theory of Storage, carry embeds a convenience yield associated with inventory and stockout risk, providing compensation for commodity-specific risks.

Panel A of Table 4 shows that, over the full sample, the excess spot return (3.18%) and interest-adjusted carry (2.90%) are similar in magnitude. Their sum slightly exceeds the total futures excess return because the residual term averages −0.71%. Despite comparable average contributions, the two components exhibit sharply different equity exposures. The market beta of the spot excess return is 0.25, virtually identical to that of the total futures return, while the beta of interest-adjusted carry is economically indistinguishable from zero (beta < 0.0005). Because the market beta of the total futures return must equal the sum of the component betas, the fact that the spot beta matches the total beta implies that systematic equity risk is entirely embedded in spot returns.

The same pattern holds across subperiods (Panel B) and under the time-varying specification (Panel C). Betas for spot returns vary systematically with macroeconomic conditions, mirroring the behavior of the overall futures return, whereas carry remains orthogonal to equity market risk.

The empirical decomposition mirrors Hirshleifer's (1988) theoretical distinction between a systematic market component and a commodity-specific residual component. The systematic component of the commodity risk premium operates through spot price appreciation and reflects exposure to broad macroeconomic risks that covary with equities. The commodity-specific component is embedded in carry and compensates investors for the risk of physical stockouts. The unexplained premium identified in the factor regressions is therefore concentrated in carry rather than in the dynamics of spot prices.

A final observation concerns the evolution of carry over time. The average carry component was stable in the pre-1960 and 1960–2004 subperiods at 3.38% ($t = 7.0$) and 3.31% ($t = 9.1$), respectively, but has been near zero since 2005 (−0.01%; $t = -0.02$), despite continued and significant overall excess returns. This shift implies that recent commodity premiums have been driven primarily by spot price movements rather than curve-based compensation. We leave the sources of this change in composition to future research.

5.5 Implications

Taken together, the evidence shows that equity market risk explains part, but not most, of the commodity risk premium. Equity exposure accounts for roughly one third of average excess returns over the full sample and varies systematically with macroeconomic conditions. However, a substantial residual remains even after allowing for multi-factor exposures and time-varying betas.

A decomposition of futures returns shows that systematic equity risk is concentrated in spot price appreciation, while carry, a quantitatively important component, is largely orthogonal to equity market fluctuations. Commodity risk premiums therefore reflect two distinct sources of compensation: exposure to broad macroeconomic risks through spot price movements, and compensation for commodity-specific risks embedded in the term structure of futures prices.

6. Conclusion

This paper examines two longstanding questions in the literature on commodity futures pricing using a comprehensive database of 230 contracts traded on 36 exchanges between 1871 and 2025. The breadth of the cross-section and the length of the time series allow us to revisit these questions with substantially greater statistical power than previously available.

On the first question – whether commodity futures prices embed a risk premium – the evidence is robust. We find that the commodity risk premium is pervasive at the contract level: the median contracts earns 5.16% annualized and three quarters of the contracts earn positive lifetime arithmetic excess returns. The premium is not confined to particular sectors, exchanges, geographies, or eras, indicating that the premium is a broad feature of commodity futures markets rather than an artifact of a narrow sample or specific historical episode. The majority of contracts (60%) also earn positive geometric average returns; this is in contrast to equities where the median excess return is negative. Portfolio formation enhances statistical power but does not create the premium. An equally-weighted portfolio earns a 5.46% annualized premium which is in line with the median contract level results. The portfolio premium does not depend on the rebalancing mechanics of equal-weighting, and premium estimates are significant across the three sub-periods – the most recent of which includes the financialization of commodity markets.

On the second question, we find that commodity futures have significant positive exposure to equity market risk over the 155-year history. Exposure to equity markets can explain one third of the premium over the full sample, and as much as half in sub-periods. These findings stand in contrast to the conventional wisdom in the literature, and we show that the prevailing conslusion are based on samples that overlap with the 1960-2004 period during which correlations were low from the long-term historical perspective. Equity exposure does not fully account for returns, particularly during 1960–2004. Even after allowing betas to vary with inflation and the business cycle, a residual premium remains, suggesting compensation for risks partly shared with equities and partly distinct.

A decomposition of the futures returns into spot returns and interest-adjusted carry shows that both components are about equally important in terms of explaining the level of the risk premium, but that the equity exposure is entirely concentrated in spot returns. The interest-adjusted carry embeds the convenience yield which compensates futures investors for the stockout risk of individual markets, which is consistent with the idiosyncratic nature of the risk of this component of the return.

A complete decomposition of the residual premium, after accounting for equity beta, into specific commodity-related risk sources such as hedging pressure, inventory risk, or intermediary constraints requires historical data that are not consistently available over the full 155-year period, and this direction remains an important avenue for future research. Nevertheless, the long-run evidence presented here indicates that commodity futures have systematically rewarded investors for bearing risk, and this reward has been a durable feature of global futures markets since the nineteenth century.

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Table 1: Individual Contract Risk Premiums

This table reports risk premium estimates for individual commodity futures, computed from monthly futures price data over January 1871–December 2025. For each contract, we calculate annualized arithmetic and geometric mean returns. We report the cross-sectional mean and median of these estimates, the fraction of contracts with statistically significant (at the 5% level) positive arithmetic mean returns, and the fractions with positive arithmetic and geometric mean returns. For the latter fractions, significance at the 10%, 5%, and 1% levels from a binomial test under the null that positive and negative average returns are equally likely are marked with *, **, and ***. Panel A reports results for the full sample. Panel B disaggregates by commodity sector. Panel C splits contracts by renewability, domicile, and exchange location (financial centers include Chicago, New York, and London). Panel D reports subperiod estimates.

Panel A: All Commodities

	N	Arith. Mean (Mean)	Arith. Mean (Median)	% Positive (Arith. Mean)	% Significantly Positive	Geo. Mean (Mean)	Geo. Mean (Median)	% Positive (Geo. Mean)
All	230	2.59	5.16	73.0%***	20.0%	0.88	1.64	60%***
Long-Lived (≥ 10 years)	131	6.25	5.75	87.0%***	29.8%	2.29	1.76	67.9%***
Surviving	47	5.87	6.01	93.6%***	31.9%	1.79	1.94	78.7%***
Non-Surviving	183	1.75	4.75	67.8%***	16.9%	0.65	1.38	55.2%

Panel B: By Sector

	N	Arith. Mean (Mean)	Arith. Mean (Median)	% Positive (Arith. Mean)	% Significantly Positive	Geo. Mean (Mean)	Geo. Mean (Median)	% Positive (Geo. Mean)
Softs	64	5.82	5.84	76.6%***	18.8%	3.40	1.98	62.5%**
Animal Products	42	2.13	3.77	69.0%***	11.9%	0.85	1.48	61.9%*
Grains & Oilseeds	79	-1.59	4.26	68.4%***	24.1%	-2.00	-0.25	49.4%
Energy	15	5.21	12.43	66.7%	46.7%	0.82	7.07	66.7%
Precious Metals	11	3.46	5.73	72.7%	0.0%	-0.07	0.90	54.5%
Industrial Metals	19	7.57	5.75	94.7%***	15.8%	5.08	2.41	89.5%***

Panel C: By Commodity Characteristics

	N	Arith. Mean (Mean)	Arith. Mean (Median)	% Positive (Arith. Mean)	% Significantly Positive	Geo. Mean (Mean)	Geo. Mean (Median)	% Positive (Geo. Mean)
Renewable	187	2.11	4.93	71.7%***	20.3%	0.80	1.58	57.2%**
Non-Renewable	43	4.71	5.86	79.1%***	18.6%	1.25	2.06	72.1%***
US	182	2.04	5.16	70.9%***	20.3%	0.41	1.63	57.7%**
Non-US	48	4.71	5.18	81.3%***	18.8%	2.67	1.64	68.8%***
Financial Centers	149	3.72	5.73	76.5%***	18.1%	1.31	1.68	63.8%***
Other Locations	81	0.52	4.90	66.7%***	23.5%	0.11	1.21	53.1%

Panel D: By Sub-Periods

	N	Arith. Mean (Mean)	Arith. Mean (Median)	% Positive (Arith. Mean)	% Significantly Positive	Geo. Mean (Mean)	Geo. Mean (Median)	% Positive (Geo. Mean)
1871-1959	160	1.65	5.40	71.3%***	18.8%	0.51	1.98	57.5%**
1960-2004	116	3.51	3.14	70.7%***	12.1%	1.06	0.45	52.6%
2005-2025	54	6.88	6.92	79.6%***	16.7%	2.55	2.99	68.5%***

Table 2: Portfolio Risk Premiums

This table presents risk premium estimates for portfolios. N is the number of available contracts, which may vary over time, and T is the number of time-series observations. We report the arithmetic mean with its t-statistic and the geometric mean. The geometric mean is decomposed into a strategic component, defined as the weighted average of individual contracts' geometric returns each month, and a diversification return, defined as the residual. The rightmost column shows the monthly correlation with the excess returns of the aggregate stock market. Panel A covers the full sample. Panel B disaggregates by commodity sector. Panel C splits portfolios by renewability, domicile, and exchange location. Panel D examines subperiod estimates. Panel E compares portfolios by rebalancing periods. For each panel, we test equality of arithmetic means across portfolios and provide the F-test p-value.

Panel A: All Commodities

	N	T	Arith. Mean	T-stat	Geo. Mean	Strategic Ret	Diversif. Ret	Corr with Stocks
All	230	1860	5.46	4.80	4.56	1.48	3.08	28.7%
All ex Energy	215	1860	5.17	4.56	4.26	1.42	2.85	28.8%
Long-Lived (≥ 10 years)	131	1860	5.55	4.86	4.65	1.58	3.07	28.4%
Surviving	47	1860	5.75	4.17	4.39	0.59	3.79	22.4%
F-test of equal arith. mean	p-value	0.99						

Panel B: By Sector

	N	T	Arith. Mean	T-stat	Geo. Mean	Strategic Ret	Diversif. Ret	Corr with Stocks
Softs	64	1835	5.77	3.88	4.16	1.15	3.01	24.0%
Animal Products	42	1859	4.24	2.65	2.31	0.90	1.41	22.5%
Grains & Oilseeds	79	1859	5.08	3.17	3.18	1.44	1.74	16.1%
Energy	15	581	10.70	2.53	6.77	3.51	3.26	8.0%
Precious Metals	11	1276	5.02	2.37	2.79	1.01	1.79	13.1%
Industrial Metals	19	1729	5.79	3.74	4.18	3.07	1.11	29.0%
F-test of equal arith. mean	p-value	0.56						

Panel C: By Commodity Characteristics

	N	T	Arith. Mean	T-stat	Geo. Mean	Strategic Ret	Diversif. Ret	Corr with Stocks
Renewable	187	1860	5.12	4.22	4.07	1.38	2.69	24.9%
Non-Renewable	43	1797	5.92	3.95	4.40	2.46	1.94	25.5%
F-test of equal arith. mean	p-value	0.68						
US	182	1860	5.27	4.32	4.21	1.17	3.04	27.6%
Non-US	48	1801	6.75	4.99	5.59	2.93	2.66	23.1%
F-test of equal arith. mean	p-value	0.42						
Financial Centers	149	1860	5.01	4.59	4.17	1.01	3.17	33.2%
Other Locations	81	1808	6.24	4.13	4.65	2.40	2.25	16.1%
F-test of equal arith. mean	p-value	0.51						

Panel D: By Sub-Periods

	N	T	Arith. Mean	T-stat	Geo. Mean	Strategic Ret	Diversif. Ret	Corr with Stocks
1871-1959	160	1068	5.65	3.36	4.50	2.26	2.24	33.5%
1960-2004	116	540	4.74	2.90	4.22	0.37	3.85	5.2%
2005-2025	54	252	6.23	2.25	5.56	1.44	4.11	46.6%
F-test of equal arith. mean	p-value	0.91						

Panel E: By Rebalance Frequency (EW All Contracts)

	N	T	Arith. Mean	T-stat	Geo. Mean	Strategic Ret	Diversif. Ret	Corr with Stocks
Three months	230	1860	5.71	5.00	4.82	1.52	3.29	28.8%
Six months	230	1860	5.85	5.03	4.92	1.59	3.33	28.0%
Annual	230	1860	6.32	5.34	5.38	1.69	3.69	27.6%
Three years	230	1860	6.21	5.04	5.16	1.98	3.18	25.2%
Five years	230	1860	5.92	4.74	4.83	2.12	2.70	24.6%
F-test of equal arith. mean	p-value	1.00						

Table 3: Stock market exposure and the commodity risk premium

This table reports results from regressions of monthly commodity portfolio excess returns on equity market factors. Average returns and intercepts are annualized for presentation. Each cell shows the coefficient estimate with the t-statistic below. Panel A regresses the equal-weighted commodity portfolio and sector portfolios on the excess return of the aggregate stock market $R^e_{m,t}$ over the full sample (1871–2025). Panel B regresses the equal-weighted portfolio on the Fama–French three factors augmented with the Carhart momentum factor separately for three subperiods. Panel C regresses the equal-weighted portfolio on thematic factors from Jensen, Kelly, and Pedersen (2023). Panel D estimates a time-varying beta model that allows the market beta to shift with the business cycle and inflation. The specification includes an indicator for recession D_t, an indicator for months in which year-over-year inflation exceeds zero π_t, and their interaction:

$$R^e_{c,t} = \alpha_0 + (\beta_0 + \beta_1 D_t + \beta_2 \pi_t + \beta_3 D_t \pi_t) R^e_{m,t} + \varepsilon_t$$

Panel A: CAPM over full sample

	Independent Variables							
	EW	EW ex Energy	Softs	Animal Products	Grains & Oilseeds	Energy	Precious Metals	Industrial Metals
Avg Return	5.37%	5.07%	5.77%	4.15%	4.97%	10.70%	5.02%	5.79%
	(4.72)	(4.49)	(3.88)	(2.60)	(3.11)	(2.53)	(2.37)	(3.74)
Intercept	3.70%	3.41%	3.97%	2.31%	3.66%	9.24%	3.77%	3.73%
	(3.38)	(3.13)	(2.73)	(1.47)	(2.31)	(2.16)	(1.78)	(2.50)
Market	0.25	0.25	0.27	0.28	0.20	0.15	0.16	0.33
	(12.91)	(12.96)	(10.57)	(9.96)	(7.00)	(1.93)	(4.73)	(12.56)
Nobs	1859	1859	1835	1858	1858	581	1276	1729
R-squared	8.24%	8.29%	5.75%	5.08%	2.57%	0.64%	1.73%	8.37%

Panel B: EW on Fama-French factors

	1926-2025			*1926-1959*			*1960-2004*			*2005-2025*		
Avg Return	5.48%	5.48%	5.53%	6.01%	6.01%	6.18%	4.74%	4.74%	4.74%	6.23%	6.23%	6.23%
	(4.27)	(4.27)	(4.30)	(2.32)	(2.32)	(2.36)	(2.90)	(2.90)	(2.90)	(2.25)	(2.25)	(2.25)
Intercept	3.43%	2.87%	2.73%	2.38%	2.05%	1.39%	4.52%	4.08%	4.21%	2.49%	2.48%	2.34%
	(2.84)	(2.42)	(2.24)	(1.07)	(0.95)	(0.62)	(2.75)	(2.42)	(2.42)	(1.00)	(1.00)	(0.94)
Market	0.25	0.20	0.20	0.34	0.26	0.26	0.04	0.03	0.03	0.39	0.39	0.40
	(13.27)	(10.08)	(9.87)	(12.32)	(7.62)	(7.67)	(1.22)	(0.89)	(0.84)	(8.32)	(7.98)	(7.84)
SMB		0.12	0.13		0.24	0.25		0.09	0.09		-0.11	-0.10
		(3.76)	(3.81)		(4.26)	(4.32)		(2.05)	(2.04)		-(1.24)	-(1.15)
HML		0.17	0.18		0.10	0.14		0.05	0.04		0.16	0.17
		(6.14)	(6.06)		(1.89)	(2.48)		(0.84)	(0.78)		(2.43)	(2.54)
MOM			0.02			0.06			-0.01			0.04
			(0.71)			(1.55)			-(0.30)			(0.73)
Nobs	1194	1194	1188	402	402	396	540	540	540	252	252	252
R-squared	12.88%	16.70%	16.86%	27.50%	32.34%	33.12%	0.28%	1.10%	1.11%	21.67%	23.85%	24.02%

Panel C: EW on Jensen et al. (2023) factors

Avg Return	6.03%	4.70%	6.48%	5.46%	5.46%	5.54%	5.61%	5.54%	5.61%	5.46%	5.46%	5.45%	5.63%	4.70%	4.70%
	(4.66)	(3.62)	(4.95)	(4.23)	(4.23)	(4.29)	(4.32)	(4.29)	(4.32)	(4.23)	(4.23)	(4.22)	(4.34)	(3.62)	(3.62)
Intercept	5.61%	5.61%	6.20%	5.41%	5.83%	6.26%	6.20%	5.46%	6.48%	6.31%	6.21%	4.70%	6.19%	3.75%	3.35%
	(4.26)	(4.17)	(4.71)	(4.25)	(4.81)	(4.92)	(4.77)	(4.21)	(5.26)	(4.94)	(4.75)	(3.77)	(4.82)	(2.60)	(2.20)
accruals	0.16													0.37	0.03
	(1.69)													(3.17)	(0.82)
debt_issuance		-0.39												-0.27	0.39
		-(2.51)												-(1.09)	(3.26)
investment			0.08											-0.21	-0.26
			(1.87)											-(1.22)	-(1.07)
low_leverage				0.23										-0.06	-0.21
				(6.01)										-(0.35)	-(1.25)
low_risk					-0.33									-0.47	-0.03
					-(12.72)									-(7.34)	-(0.17)
momentum						-0.19								0.14	-0.43
						-(6.86)								(2.58)	-(5.15)
profit_growth							-0.18							-0.07	0.14
							-(3.88)							-(0.45)	(2.60)
profitability								0.04						0.52	-0.06
								(0.80)						(3.48)	-(0.41)
quality									-0.33					-0.56	0.50
									-(11.45)					-(4.00)	(3.39)
seasonality										-0.60				0.66	-0.56
										-(6.33)				(3.01)	-(3.99)
short_term_reversal											-0.25			0.12	0.70
											-(3.22)			(1.19)	(3.11)
size												0.33		0.05	0.10
												(9.37)		(0.62)	(0.99)
value													-0.20	0.16	0.05
													-(5.73)	(1.17)	(0.68)
Market															0.17
															(1.24)
Nobs	948	878	1128	1187	1187	1185	1176	1185	1176	1187	1187	1188	1177	878	878
R-squared	0.30%	0.71%	0.31%	2.96%	12.01%	3.83%	1.27%	0.05%	10.04%	3.27%	0.87%	6.89%	2.72%	13.88%	13.95%

Panel D: Time-varying betas

	Independent Variables							
	EW	EW ex Energy	Softs	Animal Products	Grains & Oilseeds	Energy	Precious Metals	Industrial Metals
Avg Return	5.37%	5.07%	5.77%	4.15%	4.97%	10.70%	5.02%	5.79%
	(4.72)	(4.49)	(3.88)	(2.60)	(3.11)	(2.53)	(2.37)	(3.74)
α_0	3.97%	3.67%	4.48%	2.79%	3.66%	10.00%	4.20%	4.04%
	(3.60)	(3.33)	(3.06)	(1.76)	(2.28)	(2.32)	(1.96)	(2.67)
β_0	0.24	0.24	0.25	0.27	0.20	0.07	0.04	0.33
	(6.25)	(6.30)	(5.06)	(4.95)	(3.68)	(0.41)	(0.66)	(6.37)
β_1	0.11	0.10	0.17	0.14	0.06	0.83	0.10	0.06
	(2.12)	(1.97)	(2.40)	(1.87)	(0.82)	(2.59)	(1.12)	(0.89)
β_2	-0.02	-0.02	-0.06	-0.08	0.00	0.05	0.15	-0.06
	-(0.39)	-(0.41)	-(0.86)	-(1.06)	(0.01)	(0.22)	(1.72)	-(0.89)
β_3	-0.21	-0.19	-0.23	-0.16	-0.28	-1.03	0.04	-0.02
	-(2.52)	-(2.29)	-(2.13)	-(1.31)	-(2.30)	-(2.61)	(0.26)	-(0.19)
Nobs	1859	1859	1835	1858	1858	581	1276	1729
R-squared	8.94%	8.89%	6.60%	5.65%	3.01%	2.25%	2.23%	8.56%

Table 4: Decomposition of Commodity Excess Returns and Equity Exposure

This table reports regressions of the components of the equally-weighted commodity portfolio excess return on equity market factors. We decompose the portfolio excess return into excess spot return, interest-adjusted carry, and a residual term. Coefficient estimates and *t*-statistics are reported for each component. Panel A reports CAPM regressions over the full sample. Panel B reports CAPM regressions separately for three subperiods. Panel C estimates the time-varying beta specification, allowing the market beta to vary with recession and inflation indicators.

Panel A: Decomposition over full sample

	Independent Variables			
	EW	Spot ER	Int. Adj. Carry	Residual
Avg Return	5.37%	3.18%	2.90%	-0.71%
	(4.72)	(2.78)	(9.50)	-(14.94)
Intercept	3.70%	1.51%	2.90%	-0.70%
	(3.38)	(1.37)	(9.42)	-(14.62)
Market	0.25	0.25	0.00	0.00
	(12.91)	(12.86)	(0.07)	-(1.88)
Nobs	1859	1859	1859	1859
R-squared	8.24%	8.17%	0.00%	0.19%

Panel B: Subsamples

	1871-1959				*1960-2004*				*2005-2025*			
	EW	Spot ER	Int. Adj. Carry	Residual	EW	Spot ER	Int. Adj. Carry	Residual	EW	Spot ER	Int. Adj. Carry	Residual
Avg Return	5.48%	2.83%	3.38%	-0.69%	4.74%	2.13%	3.31%	-0.75%	6.23%	6.88%	-0.01%	-0.67%
	(3.27)	(1.68)	(7.01)	-(10.68)	(2.90)	(1.30)	(9.10)	-(7.99)	(2.25)	(2.43)	-(0.02)	-(8.64)
Intercept	3.46%	0.86%	3.33%	-0.68%	4.52%	1.85%	3.38%	-0.75%	2.49%	3.06%	0.05%	-0.64%
	(2.18)	(0.53)	(6.86)	-(10.44)	(2.75)	(1.12)	(9.27)	-(7.93)	(1.00)	(1.20)	(0.09)	-(8.18)
Market	0.31	0.31	0.01	0.00	0.04	0.05	-0.01	0.00	0.39	0.39	-0.01	0.00
	(11.59)	(11.26)	(0.95)	-(1.72)	(1.22)	(1.63)	-(1.87)	-(0.12)	(8.32)	(8.31)	-(0.59)	-(2.01)
Nobs	1067	1067	1067	1067	540	540	540	540	252	252	252	252
R-squared	11.19%	10.64%	0.09%	0.28%	0.28%	0.49%	0.64%	2.82E-05	21.67%	21.66%	0.14%	1.58%

Panel C: Time-varying betas

	Independent Variables			
	EW	Spot ER	Int. Adj. Carry	Residual
Avg Return	5.37%	3.18%	2.90%	-0.71%
	(4.72)	(2.78)	(9.50)	-(14.94)
α_0	3.97%	1.80%	2.89%	-0.70%
	(3.60)	(1.62)	(9.31)	-(14.67)
β_0	0.24	0.23	0.01	0.00
	(6.25)	(5.86)	(0.85)	-(0.44)
β_1	0.11	0.12	0.00	0.00
	(2.12)	(2.25)	(0.09)	-(1.78)
β_2	-0.02	0.00	-0.02	0.00
	-(0.39)	(0.04)	-(1.07)	-(0.05)
β_3	-0.21	-0.20	-0.02	0.01
	-(2.52)	-(2.43)	-(0.88)	(2.05)
Nobs	1859	1859	1859	1859
R-squared	8.94%	8.73%	0.26%	0.60%