Original Article

Evidence on normal backwardation and forecasting theory in futures markets

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ABSTRACT This paper tests the theory of normal backwardation versus forecasting theory in futures markets. The study examines the characteristics of price movements in 29 markets from 1987 to 2007. Empirical evidence indicates that both theories exist and the dominant mechanism varies in different markets. Despite the cross-sectional differences across futures markets, the prevailing mechanism in each market is relatively sustainable across time. The majority of the markets experience no change in the dominance of the functional mechanism. However, some markets do switch the dominant mechanisms over the sample period. The results have important implications on understanding the futures risk premium and the hedging needs in different futures markets.

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INTRODUCTION

There are two seemingly opposing theories proposed to explain the returns of traders in futures markets. The ‘theory of normal backwardation’ (or its counterpart, ‘contango’) views speculative returns as directly linked to the bearing of risk. On the other hand, the so-called ‘forecasting theory’ argues that returns are determined by the ability of traders (in this case

speculators) to forecast prices accurately. Hence futures prices are unbiased predictors of the subsequently developed spot price.

Though these two theories have been tested experimentally in the literature,^{1–3} the results are mixed. In addition, prior studies^{4–7} typically focus on certain specific futures market over relatively short periods and do not analyze whether the change of market conditions would

affect the application of the theories. In this study, we analyze various types of futures market separately using 13 920 semimonthly observations covering 29 markets for 20 years starting from 1987. This broader coverage makes possible more conclusive inferences about the mechanism that may have been operative in futures markets.

Methodologically we use a non-parametric method to test the existence of the two theories in futures markets, including agriculture, mineral, currency and financial markets. This allows us to avoid the bad model problem in prior literature. For each market, we study the semi-month price movements over the last 20 years. A strong upward or downward trend indicates the dominance of backwardation or contango. On the other hand, if we cannot identify any one-way direction, it supports the forecasting theory.

Our results show that normal backwardation (cantango) and forecasting theories may not be mutually exclusive even though they can be competitive. We present evidence on the cross-sectional heterogeneity in that one theory may operate as the dominant mechanism in different markets. Interestingly, we find that while the theory of normal backwardation/contango may be valid for particular markets as mineral and currency futures markets, it is not adequate as a general explanation of the flow of profits in some commodity markets. For example, it is the forecasting ability and not the bearing of risk that determines the profits of speculators in the grain markets. On the other hand, in financial futures markets, the backwardation dominates.

Further, we investigate whether the mechanism would change over time in each market by analyzing the futures price movements

in two sub-periods. We show that the mechanisms have certain degrees of sustainability. The dominant mechanism remains the same for the majority of markets. However, some markets do experience changes of the dominance over time. Therefore, we argue that both backwardation/contango and forecasting exist in the futures markets and the prevailing mechanism varies cross-sectionally and (possibly) time-seriesly. There is no general rule and requires that researchers and practitioners treat each market differently.

Identifying the dominant mechanism in the futures markets has important implications to the market participants as it determines the returns to traders and the costs of hedging. The theory of normal backwardation assumes that the speculators are net long and require positive profits. Thus the theory predicts that futures prices normally will rise in the duration of each contract. In the case of contango, the hedgers are net long hence the price of the futures contract would fall over its life to ensure positive profits to speculators. In the simplest form, both backwardation and contango argue that speculators are unable to forecast prices.⁸ Therefore all of their profits would be a reward for risk-bearing and none be a reward for forecasting skills. The profit flow between hedgers and speculators is analogous to the flow of insurance premiums between the insured and the insurer.

On the other hand, the forecasting theory argues that there is no clear trend of price movement in futures markets. Instead, there exists a subset of speculators who can forecast price changes. All important profit flows could be explained as a reward to their forecasting ability; and the proportion of profits attributed to normal backwardation (or contango) is zero.

The speculators' activities tend to cause futures prices on average to be an unbiased estimate of the ultimate spot price. Under this circumstance the degree of investors' forecasting ability controls the flow of profits.

The remainder of the paper is organized as follows. We discuss the theory of backwardation and forecasting and analyze the specific aspects of forecasting skills in Section II and Section III, which provides a theoretical foundation for our empirical tests. We present our data and empirical analysis in Section IV. Section V concludes.

THEORY OF BACKWARDATION AND FORECASTING

The theory of normal backwardation predicts that under certain assumptions it is necessary for the price of futures contracts to rise on average. As originally stated by Keynes,⁹ the theory assumes that speculators are net long and risk averse (that is, they require a positive history of profits if they are to continue trading). Under these circumstances, a rising trend in prices is the mechanism that rewards long speculators for the risks they bear. Keynes⁹ further denounces the possibility that speculators may be better forecasters than hedgers. As a result, the speculators' inability to forecast accurately makes them dependent upon the incidental, and probably unanticipated, rising price level to guarantee a positive history of profits. Therefore, it is unambiguous to interpret whatever profits they receive as a risk premium paid to them by hedgers and not as a reward for forecasting.

The postulation of 'no forecasting ability', however, raises problems concerning the prediction that prices must rise (or fall).

Keynes' assumptions of normal backwardation (contango) are neither necessary nor sufficient for the prediction on the price movement. For example, the 'hedging pressure' argument proposes that the direction of price change is directly related to the magnitude of short hedges. If the level of the net short position of hedgers is subject to variations, it is possible for speculators to have a positive history of profits without prices increasing on average. To address this issue, Hicks¹⁰ and Houthakker¹¹ reformulated the theory of normal backwardation by incorporating the speculators' ability to forecast prices. Granting speculators even a modest amount of predictive ability makes it impossible for speculators to be net long during periods when prices fall in a 'predictable' manner. Hicks-Houthakker version of normal backwardation necessarily implies that prices must rise on average. However, this improvement in the logic of theory is gained at a cost. The returns of speculators may no longer be viewed unambiguously as a reward for bearing risk. Rather they represent a mixed payment for forecasting and risk bearing, with the proportions of the mixture being determinable only by empirical investigation. The view held by Keynes⁹ that the returns of speculators may be interpreted as an insurance premium will be valid only if the forecasting component of profits is relatively small.

Empirically it would be interesting to measure a normal backwardation component of profits and then define the difference between this amount and the actual returns as the forecasting component. Note a couple of problems arise in defining an empirical estimate of the normal backwardation. The first problem is the case of contango when hedgers are net long rather than net short. The Keynes⁹ and

Hicks-Houthakker,^{10,11} formulations clearly assume hedgers to be net short. This can be easily addressed by taking opposition positions of normal backwardation in case of contango. The second problem concerns with the weights to be used in aggregating over individual contracts and commodities. There are at least three possibilities: (1) each contract may be given a weight of one; (2) each contract may be given a weight equal to the average value of the open interest in that contract; and (3) each contract may be weighted by the actual open interest existing on that date. The first alternative, unity weights, gives undue importance to inactive contracts and commodities and need not be considered. The choice between options two and three is more difficult. Numerous arguments can be made for either side. The most important consideration would be the protection against misleading results caused by changing market structure.

In this paper, we focus on analyzing the prevailing mechanism in futures markets. Hicks-Houthakker's unambiguous prediction on price movement enables us to identify the mechanism by analyzing the price trend over our long sample period. A persistently strong upward (downward) movement would imply the theory of normal backwardation (contango). This is in the same logic as measuring normal backwardation as the sum of the return on the total long open interest when hedgers are net short. Normal backwardation describes the profits of *marginal* speculators who possess no forecasting ability. We may therefore conceive of normal backwardation as the return earned by a hypothetical speculator who follows a naive strategy of being constantly long when hedgers are net short. The naive strategy may

assume that the hypothetical trader adjusts the size of his positions to maintain them as a constant proportion of the total open interest. If normal backwardation is defined as the returns which a naive speculator earns by keeping his commitments long, in proportion to the total open interest when hedgers are net short, then the rate of return on the total long open interest is closely related to the rate of normal backwardation. Likewise, the same can be said in case of contango when hedgers are net long.

FORECASTING SKILLS

If no consistent evidence of normal backwardation (or contango) could be identified, it would imply the acceptance of the extreme alternative hypothesis that all important profit flows are to be explained in terms of forecasting ability. It worth mentioning that it is possible to define two levels of forecasting skill: first, an elementary ability which is called basic forecasting skill; and the second, a more sophisticated ability which can be dubbed as special forecasting skill. Basic skill measures the ability of a group to be long in markets where prices rise over the total period of observation and short in markets where prices fall over the total period of observation. Whereas special skill measures a trader's ability to forecast price movements whose duration is shorter than the total period of observation.

Let V_m^L and V_m^S be total value of trading group's long and short commitments in a single market m aggregated over time periods. Define R_m^B the rate of return on the long open interest in that market. Then any net trading group's rate of profit attributable to the basic forecasting skill is given by $R_m^B = (R_m(V_m^L - V_m^S)) / (V_m^L + V_m^S)$

Denoting the groups actual rate of return by R_m^A we then obtain the measure of the special forecasting skill as residual of $R_m^F = R_m^A - R_m^B$. In the aggregate, we have

$$R^B = \frac{\sum_m R_m (V_m^L - V_m^S)}{\sum_m (V_m^L + V_m^S)} \quad \text{and} \quad R^F = R^A - R^B$$

The measure R_m^B will be positive when R_m is positive and the group is net long on average ($V_m^L - V_m^S > 0$) or when R_m is negative and the group is net short on average ($V_m^L - V_m^S < 0$). So the measure discussed here defines the basic skill as the ability to be net long on average in markets where prices rise on average, and to be net short on average in markets where prices fall on average. This measures the long term ability of a trading group to stay on the profitable side of the market. In the mean time, the special forecasting skill measures the success with which a trading group varies its position, from period to period to profit from short run price trends. These forecasting skills should be necessary especially when backwardations or contangos are not evident in the price structures.

OPERATIONAL MECHANISMS IN FUTURES MARKETS

Data and methodology

All futures settlement prices from 15 June 1987 through 31 May 2007 are collected from Futures section in the *Wall Street Journal* (WSJ) and *Investor's Business Daily* (IBD). In order to make semimonthly data, we group data from the first day to fifteenth day of the month as one set and

sixteenth day of the month to last day of the month as the other set. If the fifteenth day falls on holidays we use the closest day which gives two sets as equal as possible. Accordingly, for each futures contract, we have 480 data points. The first data point is recorded on 30 June 1987 (settlement price on 30 June 1987 minus settlement price on 15 June 1987), and the last one is obtained on 31 May 2007 (settlement price on 31 May 2007 minus settlement price on 15 May 2007). Then we count how many times the price is increased, and how many times the price is decreased during that semimonthly period over the last 20 years.

For each futures market, we report the prices of the start point and end point and calculate the change in price during the period. Price changes are based on the most actively trading months. The average annual percentage price change of the contract during the period is obtained by:

$$\begin{aligned} &\text{Annual percentage price change} \\ &= \frac{(P_{\text{end}} - P_{\text{start}}) / P_{\text{start}}}{\text{Number of Years}} \times 100 \end{aligned}$$

We then count the number of the semiannual periods where there have been price increases and calculate the fraction of the number of increasing periods to the total number of periods.

To investigate the evolution of the mechanisms in futures markets, we split the overall sample into two subsamples over 1987–1997 and over 1997–2007 respectively. Each sub-period sample has 240 data points. In doing so, we want to analyze whether the dominance of one mechanism in each futures market is stable and sustainable over time.

Our methodology generates the following predictions:

Hypothesis 1: If the fraction of the number of increasing periods to total number of periods is greater than 50 per cent, the market moves upwardly for the majority of time. This indicates that the backwardation has happened and long positions are actually profitable during those periods. The mechanism of backwardation suggests the demand for seller hedging.

Hypothesis 2: If the fraction of the number of increasing periods to total number of periods is less than 50 per cent, the market moves downwardly for the majority of time. This indicates that the contango has happened and short positions are actually profitable during those periods. The mechanism of contango suggests the demand for buyer hedging.

Hypothesis 3: If the fraction of the of number increasing periods to total number of periods is close to 50 per cent, it rejects the possibility of backwardation while supporting the forecasting argument. The mechanism of forecasting suggests that the profit is determined by trader's forecasting ability.

Results

Tables 1, 2 and 3 report futures contracts and markets, period of observation, numbers of semimonthly observations, change in price level during the period, annual percentage change, and number of semimonthly periods with price increases over the overall sample

period and two sub-periods, respectively.

The last column shows the number of the semiannual periods with increasing prices.

The percent value in the parentheses report the fraction of the number of increasing periods to the total number of periods.

Figure 1 graphs the ratio for each market over three periods. If the ratio is within the one percentage points around 50 per cent (that is, 49 per cent – 51 per cent), the forecasting theory dominates; if the ratio is greater than 51 per cent, the backwardation dominates; if the ratio is less than 49 per cent the contango dominates. Table 4 presents the frequency of the dominance of each mechanism for all the future markets.

Cross-sectional heterogeneity

The results show that there exists heterogeneity across markets. Backwardation (contango) and forecasting mechanisms coexist in futures markets. Table 4 shows that backwardation, contango and forecasting account for 41.38 per cent, 34.48 per cent and 24.14 per cent, respectively. In the following paragraphs we will analyze each market in detail and discuss the implications behind the functional mechanisms.

Quite contrary to a *priori* belief that the grain markets may show sellers hedging (farmer's incentive to hedge), we find that it is the forecasting theory that has dominated the grain futures markets during the last 20 years. Prices increase almost half of the periods (49 per cent–51 per cent) in overall grain markets, indicating the traders forecasting ability may have determined their profits (forecasting theory). Only wheat futures market shows mild buyer hedging (48 per cent).

Table 1: Markets and price movement: 1987–2007

Commodity and markets	Period of observation		Number of semi-monthly observations	Price change		Annual % price change	% of increasing prices (%)
	From	To		Start	End		
Agriculture							
Com, CBOT	6/87	5/07	480	186.5	386.75	+ 5.37	238 (50%)
Beans, CBOT	6/87	5/07	480	543.25	817.5	+ 2.61	247 (51%)
Meal, CBOT	6/87	5/07	480	166.2	221.4	+ 1.66	239 (50%)
S-Oil, CBOT	6/87	5/07	480	17.53	35.81	+ 5.21	242 (50%)
Wheat, CBOT	6/87	5/07	480	263.25	520.75	+ 4.89	231 (48%)
F-Cattle, CME	6/87	5/07	480	70.92	110.25	+ 2.77	247 (51%)
L-Cattle, CME	6/87	5/07	480	63.30	90.67	+ 2.16	273 (57%)
Hogs*, CME	6/87	5/07	480	71.75	75.15	+ 0.02	258 (54%)
P-Bellies, CME	6/87	5/07	480	69.32	98.70	+ 2.12	241 (50%)
Cocoa, CSCE	6/87	5/07	480	1997	1883	−0.03	208 (43%)
Coffee, CSCE	6/87	5/07	480	105.75	117.4	+ 0.06	217 (45%)
Sugar, CSCE	6/87	5/07	480	6.97	9.24	+ 1.62	247 (51%)
Cotton, NYCE	6/87	5/07	480	72.80	50.48	−1.53	229 (48%)
OJ, NYCE	6/87	5/07	480	125.3	154.65	+ 1.17	225 (47%)
Mineral							
Copper, CMX	6/87	5/07	480	71.45	340.50	+ 18.83	261 (54%)
Gold, CMX	6/87	5/07	480	452.2	689.6	+ 2.62	222 (46%)
Platinum, NYM	6/87	5/07	480	560.3	1295.6	+ 9.32	256 (53%)
Silver, CMX	6/87	5/07	480	741.0	1374.0	+ 4.27	232 (48%)
Crude Oil, NYM	6/87	5/07	480	20.05	65.08	+ 12.23	266 (55%)
Heating Oil, NYM	6/87	5/07	480	0.554	1.923	+ 12.36	259 (54%)
Gasoline**, NYM	6/87	5/07	480	0.544	2.245	+ 15.65	273 (57%)
Lumber 1, CME	6/87	5/07	480	183.8	277.7	+ 2.55	226 (47%)
Currency							
Japanese Yen, CME	6/87	5/07	480	6863	8210	+ 0.98	201 (42%)
Canadian Dollar, CME	6/87	5/07	480	0.749	0.942	+ 1.29	276 (58%)
British Pound, CME	6/87	5/07	480	1.610	1.982	+ 1.15	253 (53%)
Swiss Franc, CME	6/87	5/07	480	0.666	0.814	+ 1.11	225 (47%)
Financial							
Eurodollar, CME	6/87	5/07	480	92.58	94.65	+ 0.12	259 (54%)
T-Bonds, CBOT	6/87	5/07	480	91.16	108.17	+ 0.93	269 (56%)
S & P 500, CME	6/87	5/07	480	503.55	1539.6	+ 10.29	278 (58%)

*Live Hogs (before December 1996) were based on conversion factor of 0.74 of lean hogs.

**NY Harbor Gas Blend was used since November 2006.

Table 2: Markets and price movement: 1987–1997

Commodity and markets	Period of observation		Number of semi-monthly observations	Price change		Annual % price change	% of increasing prices (%)
	From	To		Start	End		
Agriculture							
Com, CBOT	6/87	5/97	240	186.5	270.75	+ 4.51	121 (50%)
Beans, CBOT	6/87	5/97	240	543.25	880.5	+ 6.21	116 (48%)
Meal, CBOT	6/87	5/97	240	166.2	290.5	+ 7.47	114 (48%)
S-Oil, CBOT	6/87	5/97	240	17.53	23.78	+ 3.57	120 (50%)
Wheat, CBOT	6/87	5/97	240	263.25	360.5	+ 3.69	124 (52%)
F-Cattle, CME	6/87	5/97	240	70.92	78.32	+ 1.04	136 (57%)
L-Cattle, CME	6/87	5/97	240	63.30	64.92	+ 0.03	141 (59%)
Hogs*, CME	6/87	5/97	240	71.75	80.65	+ 1.24	130 (54%)
P-Bellies, CME	6/87	5/97	240	69.32	86.37	+ 2.46	104 (43%)
Cocoa, CSCE	6/87	5/97	240	1997	1469	−2.64	98 (41%)
Coffee, CSCE	6/87	5/97	240	105.75	276.4	+ 16.14	112 (47%)
Sugar, CSCE	6/87	5/97	240	6.97	11.17	+ 6.03	126 (53%)
Cotton, NYCE	6/87	5/97	240	72.80	72.45	−0.04	129 (54%)
OJ, NYCE	6/87	5/97	240	125.3	76.6	−3.89	109 (45%)
Mineral							
Copper, CMX	6/87	5/97	240	71.45	119.1	+ 6.67	135 (56%)
Gold, CMX	6/87	5/97	240	452.2	352.7	−2.20	108 (45%)
Platinum, NYM	6/87	5/97	240	560.3	401.2	−2.84	112 (47%)
Silver, CMX	6/87	5/97	240	741.0	467.5	−3.69	100 (42%)
Crude Oil, NYM	6/87	5/97	240	20.05	20.88	−0.04	131 (55%)
Heating Oil, NYM	6/87	5/97	240	0.554	0.5649	+ 0.20	126 (53%)
Gasoline**, NYM	6/87	5/97	240	0.544	0.6368	+ 1.72	132 (55%)
Lumber 1, CME	6/87	5/97	240	183.8	380.5	+ 10.70	121 (50%)
Currency							
Japanese Yen, CME	6/87	5/97	240	6863	8622	+ 2.56	102 (43%)
Canadian Dollar, CME	6/87	5/97	240	0.749	0.727	−0.30	136 (57%)
British Pound, CME	6/87	5/97	240	1.610	1.640	+ 0.19	131 (55%)
Swiss Franc, CME	6/87	5/97	240	0.666	0.709	+ 0.65	122 (51%)
Financial							
Eurodollar, CME	6/87	5/97	240	92.58	94.01	+ 0.15	138 (58%)
T-Bonds, CBOT	6/87	5/97	240	91.16	110.01	+ 2.03	128 (53%)
S & P 500, CME	6/87	5/97	240	503.55	850.6	+ 6.89	145 (60%)

Table 3: Markets and price movement: 1997–2007

Commodity and markets	Period of observation		Number of semi-monthly observations	Price change		Annual % price change	% of increasing prices (%)
	From	To		Start	End		
Agriculture							
Com, CBOT	6/97	5/07	240	270.75	386.75	+ 4.83	117 (49%)
Beans, CBOT	6/97	5/07	240	880.5	817.5	−0.72	131 (55%)
Meal, CBOT	6/97	5/07	240	290.5	221.4	−2.38	125 (52%)
S-Oil, CBOT	6/97	5/07	240	23.78	35.81	+ 5.05	122 (51%)
Wheat, CBOT	6/97	5/07	240	360.5	520.75	+ 4.44	107 (45%)
F-Cattle, CME	6/97	5/07	240	78.32	110.25	+ 4.46	111 (46%)
L-Cattle, CME	6/97	5/07	240	64.92	90.67	+ 3.97	132 (55%)
Hogs*, CME	6/97	5/07	240	80.65	75.15	−0.68	128 (53%)
P-Bellies, CME	6/97	5/07	240	86.37	98.70	+ 1.43	137 (57%)
Cocoa, CSCE	6/97	5/07	240	1469	1883	+ 2.82	110 (46%)
Coffee, CSCE	6/97	5/07	240	276.4	117.4	−5.75	105 (44%)
Sugar, CSCE	6/97	5/07	240	11.17	9.24	−1.73	121 (50%)
Cotton, NYCE	6/97	5/07	240	72.45	50.48	−3.03	100 (42%)
OJ, NYCE	6/97	5/07	240	76.6	154.65	+ 10.19	116 (48%)
Mineral							
Copper, CMX	6/97	5/07	240	119.1	340.5	+ 18.59	126 (53%)
Gold, CMX	6/97	5/07	240	352.7	689.6	+ 9.55	114 (48%)
Platinum, NYM	6/97	5/07	240	401.2	1295.6	+ 22.29	144 (60%)
Silver, CMX	6/97	5/07	240	467.5	1374.0	+ 19.39	132 (55%)
Crude Oil, NYM	6/97	5/07	240	20.88	65.08	+ 21.17	135 (56%)
Heating Oil, NYM	6/97	5/07	240	0.565	1.9228	+ 24.04	133 (55%)
Gasoline**, NYM	6/97	5/07	240	0.637	2.2450	+ 25.25	141 (59%)
Lumber 1, CME	6/97	5/07	240	380.5	277.7	−2.70	105 (44%)
Currency							
Japanese Yen, CME	6/97	5/07	240	8622	8210	−0.48	99 (41%)
Canadian Dollar, CME	6/97	5/07	240	0.727	0.942	+ 2.96	140 (58%)
British Pound, CME	6/97	5/07	240	1.640	1.982	+ 2.08	122 (51%)
Swiss Franc, CME	6/97	5/07	240	0.709	0.814	+ 1.48	103 (43%)
Financial							
Eurodollar, CME	6/97	5/07	240	94.01	94.65	+ 0.07	121 (50%)
T-Bonds, CBOT	6/97	5/07	240	110.01	108.17	+ 0.17	141 (59%)
S & P 500, CME	6/97	5/07	240	850.6	1539.6	+ 8.10	133 (55%)

Figure 1: Percentage of increasing prices.

Table 4: Frequency of the dominance of mechanisms

	1987–2007		1987–1997		1997–2007	
	No. of market	%	No. of market	%	No. of market	%
Forecasting	7	24.14	4	13.79	5	17.24
Backwardation	12	41.38	15	51.72	14	48.28
Contango	10	34.48	10	34.48	10	34.48
Total	29	100	29	100	29	100

The remaining agriculture markets demonstrate evidence of both backwardation and contango. Live cattle and hogs markets indicate decent amount of producer's incentive to hedge, with

the prices increasing 57 per cent and 54 per cent of the periods, respectively. On the other hand, Cocoa and coffee markets show significant buyer hedging while cotton and OJ show mild buyer

hedging. The most acute form of contango is identified in the cocoa market (43 per cent). For some reason, the buyers (for example chocolate makers) have strong incentives to buy in this market to hedge their risk.

The mineral futures markets are also dominated by both backwardation and contango. Gold futures markets exhibit noticeable contango. This implies that the last 20 years of selling in the futures contracts on average may have given us higher probability of making profits in the gold futures market. Energy markets in general show backwardation. It looks like oil producing countries (for example OPEC members) are willing to pay a premium to hedge their risk.

Foreign exchange markets are mixed in that both backwardation and contango exist. Canadian Dollars market is backwardated, but Japanese Yen contract is the opposite. Japanese Yen is rather interesting. Even though the Yen has been appreciating for the last 20 years, the right strategy might have been selling in the yen futures markets, since it has shown severe contango.

Surprisingly, the most severe form of backwardation appears in the financial instruments. The backwardation in interest futures markets (Eurodollars and Tbonds) suggests a high level of premiums to be paid to buyers from sellers. For example, the US Treasury department has a strong incentive to pay insurance premium to sell government securities. Why is that? Note that last two decades we have witnessed that the general interest level has been falling. Falling interest rates (or increasing bonds prices) seem to be related with the normal backwardation in these markets. S & P 500 also shows high level of backwardation.

Time-series sustainability

In addition to analyzing the overall sample, we conduct subsample analysis to test the time-series sustainability of the functional mechanisms in each market. If the mechanism simply switches between backwardation and contango, we also treat it as no change as this only represents different buyer or seller hedging demand over different time periods in the market but not changes in the source of the profit.¹² The results show that the mechanisms possess certain degrees of sustainability in futures market. The mechanism remains the same (for pre- and post-1997 periods and overall period) for more than half of the markets (19 out of 29).

Nine markets experience changes of the dominant mechanisms over time. We observe stronger forecasting factor in British Pound, Eurodollar and Sugar markets in the post-1997 period, changing from backwardation in the pre-1997 period. On the other hand, Lumber and Swiss France markets change from contango dominance to forecasting dominance in the post-1997 period. Though we do not offer detailed explanations to account for the changes, we argue that market condition change may be one reason. In four markets (Beans, Meals, Bellies and Cattle), the prevailing mechanism switches between backwardation and contango in the pre-1997 and post-1997 periods, leading to forecasting in the overall period. In this case, the conclusion should be interpreted with caution.

Relationship between mechanisms and price change

To investigate the relationship between the mechanisms and price change, we run ordered

Table 5: Relationship between the likelihood of mechanism and price change

<i>Ind. Var.</i>	<i>1987–2007</i>	<i>1987–1997</i>	<i>1997–2007</i>
Intercept 1	11.34 (0.019)**	13.87 (0.004)***	11.47 (0.007)***
Intercept 2	13.51 (0.008)***	17.20 (0.001)***	14.33 (0.002)***
Price	−23.41 (0.015)***	−28.49 (0.003)***	−23.72 (0.005)***
<i>P</i> -value of likelihood ratio	0.006	0.000	0.001

Note: *P*-values of the coefficient estimates are reported in the parentheses under the coefficient estimates.

***, ** and * represent significance level at 1 per cent, 5 per cent and 10 per cent, respectively.

logistic regressions of the dominance of the mechanisms on the annual percentage price change. The results are reported in Table 5. A negative coefficient on Price variable indicates that a lower percentage price change is associated with increased probability of the dominance of forecasting theory. This evidence is consistent with the view that larger price movement may trigger higher hedging demand and reinforces our major argument and the dominance of the mechanism is related to the market condition.

CONCLUSIONS

This study finds that neither normal backwardation (contango) nor forecasting is a general characteristic of futures markets. Each market is unique. The data for the last 20 years reveal some counter-intuitive evidence. For example, it is quite astonishing that we cannot find any farmers' incentive to hedge their risk in the form of backwardation in grain markets. These markets are not normal-backwardation-driven. Therefore speculators who employed naive trading strategy of long positions believing that the risk

premiums were paid to them might have failed in these markets. Another surprise comes from the financial futures contracts where the extreme forms of backwardation and contango are very pronounced, whereas many may believe that forecasting skills are most needed in these markets. We do find behaviors of some futures prices quite consistent with a priori expectations. For example, the backwardation or contango in some agriculture (except grain) and mineral markets indicate strong incentives of producer or buyer hedging.

Despite the cross-sectional differences across futures markets, we find that the prevailing mechanism is somewhat sustainable across time. The majority of markets experience no change in the dominance of the functional mechanism over the sample period. However, we do document the change of hedging requirements in certain markets which may be related to the market condition. In addition, some markets show the switching of the dominant mechanism between normal backwardation (cantango) and forecasting.

This paper has important implications to futures market participants as the dominant price mechanism determines the returns to traders and

the costs of hedging. In addition, the paper raises a series of important questions that merits further consideration. Specifically, why do financial futures markets exhibit strong form of backwardation or contango; why do interest instruments contracts show sellers incentive to hedge and; why are stock index futures prices backwardated? Further research should shed more light on these issues.

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