

# Cash Settlement, Price Manipulation, and the Modigliani- Miller Theorem

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# What This Paper is About

- Does having cash settlement rather than physical delivery make it harder or easier to manipulate prices?
  - Answer: It does not matter, if futures contracts defined properly (Modigliani-Miller result)
- Does cash settlement lead to “different” types of price manipulation?
  - Answer: No, it leads to nothing new.
- Does this indifference provide useful guidelines for constructing cash-settled contracts?
  - Answer: Yes.

# “Physical Delivery” vs. “Cash Settlement”

- Physical Delivery: At expiration of futures contract, traders with short positions deliver underlying physical asset to traders with long positions.
  - T-Bonds, Grains
- Cash Settlement: At expiration of futures contract, long and short positions are liquidated and settled in cash by marking to prices observed in the cash market.
  - S&P 500 futures

# CFTC Regulation of New Cash-Settled Contracts

- Market “not subject to manipulation or distortion.”
- “Based on a cash price series that is reliable, acceptable, publicly available, and timely.”

# “Price Manipulation”

- Definition: Intentional trading strategy which influences prices so they do not reflect the “legitimate,” “natural,” “underlying,” or “market” forces of supply and demand. Creates an “artificial price.”
  - Includes corners and squeezes
  - Includes dissemination of false rumors
  - Includes dissemination of fake transactions quantities and prices for purpose of affecting prices
- Indiana Farm Bureau case:
  - Does not include failure to make markets or supply liquidity to others just because they demand it.

# Existing Literature

- Kumar and Seppi (1992)
  - Claims incorrectly that “punching the close” is manipulation associated with cash settlement.
  - Have strange theoretical microstructure which papers citing this article do not appear to appreciate
- Stoll and Whaley (1997)
  - Recognize that cash settlement is equivalent to physical delivery
- Pirrong (2001)
  - Associates delivery options with physical delivery contracts but not cash settled ones
- Dutt and Harris (2005)
  - Discuss example I critique below
- All four papers refer to exercise of monopoly power as “manipulation” in context of cash settlement, but fail to investigate consequences of exercise of monopoly power without cash settlement.
  - Effects would be identical for physical delivery

# Microstructure Assumptions

- Market-on-Expiration Orders (IMPORTANT)
- Cash-settled contract, otherwise identical physical-delivery contract.
- No transactions costs for futures arbitrage transactions (buy one, sell another)
- Identical fees and commissions
- Fungible cash-market delivery
- Netting of cash market deliveries
- Clearing House Solvency
- Identical Settlement Prices if Possible
- Expiration day mark-to-market timing
- Bids and offers subject to immediate acceptance
- Risk-free legging of spreads
- No position limits on arbitrage transactions
- Zero margin on futures arbitrage positions
- Traders prefer more to less (Implies no arbitrage)

# Allowed by Assumption

- Cash markets may not be liquid, transparent, or well-organized.
- Futures markets may not be liquid.
- Markets not competitive
- Markets subject to corners and squeezes.
- Borrowing and lending markets may not work well

# Economic Equivalence of Cash-Settled and Physical-Delivery Contracts

- “Identical Prices” means bids and asks cannot “cross” between the two potentially illiquid futures markets
  - Allowed: No arbitrage opportunity:
    - PD: 98B, 104A. CS: 97B, 101A
  - Not allowed: Arbitrage Opportunity:
    - PD: 101B, 104A. CS: 97B, 99A

# Equivalence (continued)

- Trader buys CS at 99, sells PD at 101.
- Places market-on-expiration order to buy in cash market when contract expires
  - Suppose price is 150
- Arbitrage Profit of  $101 - 99 = 2$ 
  - Profit on CS =  $150 - 99 = 51$
  - Loss on PD =  $101 - 150 = -49$

# Microstructure Equivalence

- Microstructure Equivalence = this result
  - Does not depend on competitive market, tight bid-ask spreads, transparency, good credit markets, etc.
- Static Arbitrage, e.g. futures-cash formula
$$F = (1+r)C$$
  - Depends on tight markets, tradable prices, well-function credit markets
- Dynamic Arbitrage, e.g. Black-Scholes
  - Depends on traders agreeing it is a zero-probability event that actual volatility will differ from implied volatility.

# Relaxation of Microstructure Assumptions (continued)

- Relaxing assumptions other than ability to place market-on-expiration orders creates transactions costs or risks which require capital to be deployed to conduct arbitrage trades. This makes equivalence less tight, but approximate equivalence should hold, within transactions costs bounds.

# Modigliani-Miller Idea

- If both cash-settled and physical-delivery contracts exist, then one of them is redundant
  - Same allocation of resources if one of the contracts is discontinued, since all traders will replace trading in discontinued contract with trading in the other.
- This is the main (obvious) result of this paper.
- Result is interesting because the finance literature has gotten it wrong!
  - Or perhaps is merely confused.

# Risk Transfer at Expiration

- Trader long X contracts who places a market on expiration to buy X contracts engages in no risk transfer at expiration!
  - Cash settlement reduces risk exposure by X
  - Market-on-expiration orders increase risk transfer by X
  - Therefore not net risk transfer
- Market on expiration orders have two characteristics of wash sales:
  - No risk transfer (no net change in ownership)
  - Price of transaction does not matter
- Taking delivery has the same characteristics of a wash sale:
  - No risk transfer
  - Final futures settlement price does not matter.

# Examples of Risk Transfer

- Consider trader long 30 contracts of cash-settled contract just before expiration, who places market on expiration orders:
  - Buy 30 contracts => no risk transfer
  - Buy 50 contracts => net buyer of 20 contracts
  - Buy 10 contracts => net seller of 20 contracts
  - No order => net seller of 30 contracts

# Confusion in Academic Literature

- Modified version of Dutt and Harris (2005)
- Trader long  $X$  contracts just before expiration
- Places market-on-expiration order to buy  $Q$  contracts
- Traders agree “fundamental value” = 100  
= liquidation price of cash market transactions
- Trader believes (unreasonably!) that the execution price of market-on-expiration order is  $P = 100 + \lambda Q$
- Trader recognizes that he has market power and uses it

# What is Profit-Maximizing Trade?

- Total Revenue  
 $= (100 + \lambda Q)X - (100 + \lambda Q)Q + 100Q$
- Quadratic Problem in  $Q$
- Solution:
  - Optimal  $Q = X/2$
  - Settlement price is  $100 + \lambda X/2 > 100$
  - Trader makes profit of  $\lambda X^2/4$  relative to placing no order at all

# Confusing Interpretation in Literature

- Relative to not placing a market-on-expiration order at all:
  - Trader “punches the close” by trading  $X/2$  in cash market, increasing settlement price by  $\lambda X/2$
  - Loses  $\lambda X^2/4$  on cash position
  - Makes  $\lambda X^2/2$  (twice as much) on cash-settled futures position
- Literature calls this “manipulation”:
  - “Punching the close” in cash market would not be profitable but for beneficial effect on cash settling futures position

# CFTC is Confused Too!

- Considers above trading to be illegal price manipulation
- Avista Energy case: NYMEX electricity futures play role of physical delivery contract and OTC derivatives play the role of cash settled contract.
  - “To the extent that Avista Energy’s Traders could distort the price for futures contracts with an order at the Close on Options Expiration Day that was smaller than the positions created by Avista Energy’s OTC derivatives contracts, Avista Energy’s Traders thought that they might be able to profit via an artificially created increase in the value of its OTC derivatives contracts. This would be so because the value of those contracts would exceed any losses incurred from buying NYMEX Western U.S. electricity futures contracts at an artificially high price or selling futures contracts at an artificially low price.”

# Is FSA Also Confused?

- Example of “market abuse” falling into the category of “manipulating transactions,” from “The Code of Market Conduct” (April 2007)
  - “A trader *buys* a large volume of *commodity futures*, which are *qualifying investments*, (whose price will be relevant to the calculation of the settlement value of a *derivatives* position he holds) just before the close of trading. His purpose is to position the price of the *commodity futures* at a false, misleading, abnormal or artificial level so as to make a profit from his *derivatives* position.” (1.16.2)

# What is Wrong with Manipulation Intuition?

- Price conjecture is based on the idea that the rest of the market will liquidate entire futures position by not placing a market-on-expiration order.
- Argument shows that, given this conjecture, each trader liquidates only half the position the market expects.
- For each trader to liquidate only half what others expect to be consistent with others' expectations, each trader must liquidate nothing.
- This means each trader must place a market-on-expiration order to replace entire position.

# What is Wrong (continued)

- The trader thus places market on expiration order to buy  $X$ , not  $X/2$
- Correct price conjecture is not  $P = 100 + \lambda Q$ , but rather  $P = 100 + \lambda(Q - X)$   
where  $Q-X$  is the change in the trader's net exposure.
- No risk transfer takes place at expiration.
  - This is not surprising, since traders agree on fundamental value, are not assumed to be risk averse, and were presumably “happy” with their positions a few seconds before expiration
- Optimal exercise of monopoly power has actually led to price equal fundamental value

# What is Wrong (continued)

- Suppose the rest of the market actually does demand  $X$  units of the asset at a price of 100.
- Since  $P = 100 + \lambda Q$  is the correct supply curve, the trader maximizes profits (exercising monopoly power) by buying  $Q = X/2$  contracts at expiration, as a result of which he is a net seller of  $X/2$  contracts.
  - Trader maximizes profits by supplying half the liquidity that the market would demand if the liquidity were provided for free.

# What is Wrong? (continued)

- Back to Avista case:
  - Using the notation of my example (possibly reversing buying and selling), CFTC claims that Avista manipulated prices upward by buying even though Avista was a net seller of electricity, i.e., even though Avista was supplying liquidity to the market by being a net seller.
  - If economically equivalent transactions took place with physical delivery contracts instead of cash-settled contracts, it would be obvious that Avista was supplying liquidity as a net seller of contracts.
  - CFTC is confused by cash settlement.

# A Truly Manipulative Scheme

- Assume CFTC encourages traders not to place market-on-expiration orders but rather let all positions expire.
- Suppose trader builds up large long position in cash market greater than deliverable supply, but shorts an exactly equal amount of futures.
  - This is an arbitrage position, but long leg alone is a corner
- Suppose trader lets futures cash-settle, as the CFTC encourages.
  - The “non-order” is likely to have a huge impact on prices
  - Then trader has cornered the market, without buying futures
- CFTC needs to be able to observe the cash position to diagnose the corner.
- Not a good idea to discourage market on expiration orders
  - In this case, market-on-expiration orders would have resulted in harmless netting out of all positions.

# Market on Expiration Orders

- Mechanism for placing Market-on-Expiration orders is very important.
- Not necessary to have a “cash price series that is reliable, acceptable, publicly available, and timely” in order to have equivalence between cash-settled and physical-delivery futures contracts.
- Just need to be able to buy or sell in the cash market at the settlement price.
- This is facilitated by shift from close to open in stock index futures, since order handling system operated more efficiently on open

# Market-on-Expiration Orders

- If cash market closes at settlement date, it is a good idea to settle contracts on the next day (as recently approved), since this allows market-on-expiration orders to be carried over to the next day
  - Similarly, slightly delayed open in S&P 500 is not a problem for arbitrage.

# Market-on-Expiration Orders

- To make transparent the “wash” nature of market-on-expiration orders which replace cash-settling positions, all traders with open positions should be required to place market-on-expiration “wash” orders to replace their cash-settling positions.
  - Since longs equals shorts, these can be easily netted
    - Could use ETF as delivery vehicle
  - If traders want to alter net exposure at the settlement point, they can supplement with additional orders.
  - In notation of previous example, instead of placing order  $Q$ , a wash order of size  $X$  is placed, and the trader places an additional order of size  $Q-X$ .
    - Makes transparent that  $Q-X$  is change in trader’s net exposure
    - Would also make it easier for clearing houses to monitor trader’s positions, since net exposure more easily observed.

# Pit Trading

- Market-on-expiration orders are easy to implement if there is a computerized single-price auction which determines the close.
- Pit trading makes implementation of single-price auction difficult, especially with hectic trading and a settlement price based on an average or range of prices.
  - A broker whose customer is economically a net seller may be holding buy orders if the customer only replaces part of a long position
    - Should the broker try to buy at the highest price?
    - Separating out “wash” orders to replace positions would make the broker’s task more transparent to the broker.

# Pervasiveness of Cash Settlement

- S&P 500 Futures
- Single-Stock Futures
- VWAP trades.
- Total Return Swaps
- Libor itself, LIBOR futures, loans indexed to LIBOR, interest rate swaps.
- Currencies
- Energy (Oil, Gas, Electricity)
- OTC Derivatives with Futures as Underlying (e.g. NYMEX Electricity)
- Cotton quality differentials.
- Delivery factors (T-Bond futures)
- Gold fixing, gold spot market, copper.
- Cash-settled derivatives, forced liquidations.
- Live Cattle
- Death Spiral convertible preferred,
- Prediction Markets
- Mutual fund redemptions (late trading)

# Summary

- This paper not about “convergence” of futures to cash, but rather about equivalence of two different kinds of futures.
- Cash-settled futures are equivalent to physical-delivery futures if market-on-expiration orders can be placed.
  - Replacing positions with market-on-expiration orders in cash market is economically equivalent to taking delivery with physical-delivery contracts.
- The ability to manipulate prices is not affected by whether futures contracts are cash-settled or physically delivered.
  - This is a Modigliani-Miller result.
- The academic literature and the CFTC are confused about this equivalence.
  - Avista case is an example of CFTC confusion.
  - CFTC policy may encourage “passive manipulation” by letting positions expire
- Confusion could be avoided by
  - ... making market-on-expiration orders “automatic,” and reported separately due to “wash” nature.
  - ... replacing open outcry pit trading with computerized single-price auction.
  - ... automatically settling on the next day’s open when markets are closed on expiration day.