The World Scientific Handbook of Futures Markets

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We outline several fundamental themes for the WPS Handbook of the Futures Markets. The Handbook as the others in the same series intends to be a definitive source for comprehensive and accessible information in futures markets. The emphasis is on the unique characteristics of futures markets that make them worthy of a special volume. In our judgment, futures markets are currently undergoing remarkable changes as trading is shifting from open outcry to electronic and as the traditional functions of hedging and speculation are extended to include futures as an alternative investment vehicle in traditional portfolios. The unique feature of this volume is the selection of five classic papers that lay the foundations of the futures markets and the invitation to the leading academics who do work in the area to write critical surveys in a dozen important topics.
Dating back to the 1800s (and in some ways, back to the earliest beginnings of commerce), the futures markets were initially developed to help agricultural producers and consumers manage the price risks they faced with harvesting, marketing and processing annual crops. The futures industry still serves those markets, but has also broadened along with the expansion of our economy beyond its agricultural roots. The need for efficient forward pricing and risk management mechanisms is the reason for the tremendous growth in futures markets. Futures markets enable raw material producers and users, financial intermediaries, and international trading firms to manage their price, interest rate, and exchange rate risk. And speculators throughout the world can interpret the information that converges on exchange floors to enter the futures markets as investors.

Because of its ease of use and its many economic benefits, futures trading has expanded to include numerous and varied markets throughout the world. The increased importance of futures, which can be seen by the tremendous growth in terms of volume and number of contracts, makes their study an increasing necessity in today’s financial world. In the early 1970s, approximately 13 million futures contracts were traded in the United States—most of which were agricultural. By 1999, trading volume exploded to more than 593 million, with only 11 percent related to agricultural products. During 2006, over 3.5 billion futures contracts were traded globally.

Today, there are futures contracts for interest rates, stock indexes, manufactured and processed products, nonstorable commodities, precious metals, as well as foreign currencies and foreign bonds. And the number of proposals for new contracts continues to grow.

This introductory chapter will review in detail the special characteristics of futures markets, discuss its evolution and highlight and contrast these markets to other financial markets.

Written by the editors
Malliaris and Ziemba

Part I. Classical Contributions

Chapter 2

By posting a rather general stochastic model of price change, the paper deduces a fairly sweeping theorem in which next period’s price differences are shown to be uncorrelated with (if not completely independent of) previous period’s price differences. This martingale property of zero expected capital gain will then be replaced by the slightly more general case of a constant mean percentage gain per unit time. The paper concludes that one can never get something for nothing. From a non empirical base of axioms you never get empirical results. Deductive analysis cannot determine whether the empirical properties of the stochastic model posited in the paper come at all close to resembling the empirical determinants of real world markets. That question is not investigated. Instead the author goes about proving that prices move in a random walk.
Chapter 3

Broadly speaking, the predictions of the main model seem to me to be reasonable. At closer inspection, however, one notes that large price changes are not isolated between periods of slow change; they rather tend to be the result of several fluctuations, some of which "over- shoot" the final change. Similarly, the movement of prices in periods of tranquility seems to be smoother than predicted by my process. In other words, large changes tend to be followed by large changes of either sign and small changes tend to be followed by small changes, so that the isolines of low probability of \([L(t, 1), L(t - 1, 1)]\) are X-shaped. In the case of daily cotton prices, Hendrik S. Houthakker stressed this fact in several conferences and private conversation. Such an X shape can be easily obtained by rotation from the "plus-sign shape" which was observed in Figure 4 to be applicable when \(L(t, 1)\) and \(L(t - 1, 1)\) are statistically independent and symmetric. The necessary rotation introduces the two expressions: 

\[ S(t) = (1/2)[L(t, 1) + L(t - 1, 1)] = (1/2)[\log Z(t + 1) - \log Z(t - 1)] \]

\[ D(t) = (1/2)[L(t, 1) - L(t - 1, 1)] = (1/2)[\log Z(t + 1) - 2 \log Z(t) + \log Z(t - 1)] \]

It follows that in order to obtain the X shape of the empirical isolines, it would be sufficient to assume that the first and second finite differences of \(\log Z(t)\) are two stable Paretian random variables, independent of each other and naturally of \(\log Z(t)\) (see Fig. 4). Such a process is invariant by time inversion. It is interesting to note that the distribution of \(L(1, 1)\), conditioned by the known \(L(t - 1, 1)\), is asymptotically Paretian with an exponent equal to \(2a + 1\). Since, for the usual range of \(a\), \(2a + 1\) is greater than 4, it is clear that no stable Paretian law can be associated with the conditioned \(L(t, 1)\). In fact, even the kurtosis is finite for the conditioned \(L(t, 1)\). Let us then consider a Markovian process with the transition probability I have just introduced. If the initial \(L(T_0, 1)\) is small, the first values of \(L(t, 1)\) will be weakly Paretian with a high exponent \(2a + 1\), so that \(\log Z(t)\) will begin by fluctuating much less rapidly than in the case of independent \(L(t, 1)\). Eventually, however, a large \(L(t_0, 1)\) will appear. Thereafter, \(L(t, 1)\) will fluctuate for some time between values of the orders of magnitude of \(L(t_0, 1)\) and \(-L(t_0, 1)\). This will last long enough to compensate fully for the deficiency of large values during the period of slow variation. In other words, the occasional sharp changes of \(L(t, 1)\) predicted by the model of independent \(L(t, 1)\) are replaced by oscillatory periods, and the periods without sharp change are less fluctuating than when the \(L(t, 1)\) are independent. We see that, for the correct estimation of \(a\), it is mandatory to avoid the elimination of periods of rapid change of prices. One cannot argue that they are "causally" explainable and ought to be eliminated before the "noise" is examined more closely. If one succeeded in eliminating all large changes in this way, one would have a Gaussian-like remainder which, however, would be devoid of any significance.

Chapter 4

We examine two models of commodity futures prices. The theory of storage explains the difference between contemporaneous futures and spot prices (the basis) in terms of interest changes, warehousing costs, and convenience yields. We find evidence of variation in the basis in response to both interest rates and seasonals in convenience yields. The second model splits a futures price into an expected premium and a forecast of the maturity spot price. We find evidence of forecast power for 10 of 21 commodities and time varying expected premiums for five commodities.
Chapter 5

This paper tests several hypotheses concerning time series properties of trading volume, price, short and long-term relationships between price and volume and the determinants of trading volume in foreign currency futures. The nearby contracts for British Pound, Canadian Dollar, Japanese Yen, German Mark and Swiss Franc are analyzed in three frequencies i.e, daily, weekly and monthly. Supporting evidence is found for all the five currencies that the price volatility is a determinant of the trading volume changes. Furthermore, the volatility of the prices process is a determinant of the unexpected component of the changes in trading volume. Also, there is a significant relationship between the volatility of price and the volatility of the trading volume changes for three of the five currencies in the daily frequency and for one currency in the monthly frequency.

Chapter 6

This paper shows that although some commodity futures have been trading for hundreds of years, only recently has the debate begun about including these assets in mainstream portfolios. The goal of this article was to explore the strategic and tactical opportunities that these assets present to investors. A number of studies have argued that commodity futures are an appealing long-only investment class because they have earned a return similar to that of equities. Focusing on the dangers of naive historical extrapolation raises a question, however, about what this historical evidence means. Does the average commodity futures contract have an equity-like return? Their research suggests it does not: The average excess returns of individual commodity futures contracts have been indistinguishable from zero. Might portfolios of commodity futures have equity-like returns? Here, the answer seems to be maybe. A commodity futures portfolio can have equity-like returns if it can achieve a high enough diversification return. The diversification return is a reasonably reliable source of return. Or a commodity futures portfolio can have equity-like returns by skewing portfolio exposures toward commodity futures that are likely to have positive roll or spot returns in the future. The challenge for investors is that, although spot and roll returns may be high in the future, nothing in the historical record gives investors comfort that future spot and roll returns will be substantially positive. The nuanced case for strategic allocation to long-only commodity futures extends to TAA using commodity futures. Historical evidence suggests that momentum-based strategies and strategies based on information in the term structure of futures prices have achieved attractive returns. There is no guarantee, however, that the historically observed payoff to momentum or term-structure signals will persist in the future. If an investor wishes to bet on the persistence of historical patterns of return, the empirical TAA results suggest a way to dynamically vary commodity futures allocations.
Chapter 7: Regulatory Issues and Central Counterparty Clearinghouses

The financial system exists to facilitate exchange. Assets of various sorts – land, commodities, securities, money and many other kinds of property rights – are routinely exchanged between buyers and sellers, lenders and borrowers and other kinds of counterparties. These transactions may be supported by specialized market infrastructures, such as exchanges and depositories, payment systems and clearing arrangements, or they may take place directly between buyers and sellers in more or less formal institutional environments.

Risks of various sorts – such as those arising from natural events (e.g., floods, earthquakes and tornados), war and political events (e.g., sovereign default, legal and regulatory change, nationalization, etc.) and even market fluctuations (e.g., changes in prices and the volatility of price changes) also can be exchanged. Insurance markets facilitate the pooling and diversification of risk; specialized markets for risk transference, such as forward and derivatives markets, permit counterparties to trade risk. Risk transference markets may be supported by specialized market infrastructures, including exchanges (for listed derivatives markets), alternative trading arrangements, such as “swap execution facilities” that are being introduced in some jurisdictions as a result of recent regulatory changes and traditional over-the-counter (OTC) markets. In addition a specialized form of clearing arrangement – the central counterparty (CCP) clearinghouse – is commonly used to support trading in risk transfer markets.

Modern central clearing arrangements typically involve counterparty substitution by means of novation – a means of changing contractual relationships – or an equivalent legal mechanism. As a result, the CCP becomes the “buyer to every seller and the seller to every buyer” and stands between and performs in place of its clearing member participants. This has many advantages, such as simplifying and making more transparent the credit chains that may develop in repeated transactions among market participants. It also provides a foundation for centralized risk management (such as multilateral netting and collateralization) and data processing operations (such as trade registration and reporting), that benefit clearing members of the CCP. However, centralized clearing also has some disadvantages, such as the concentration of credit, liquidity, operational and legal risk in the CCP.

Because the CCP becomes a principal to all trades with its clearing members, it must carry out the future performance obligations to which they initially agreed. The CCP acts on its own behalf (as principal) and for the mutual benefit of its clearing members by imposing risk management policies and establishing operational processes to support the settlement of transactions cleared through the CCP. It also plays a fundamental role in responding to clearing member defaults and other circumstances that threaten the orderly operation of the clearinghouse. This tends to align the CCP’s incentives with the interests of its clearing members, who are dependent upon the CCP to perform those obligations and exposed to the risk of loss in the event that a clearing member’s default or some other circumstance makes it impossible for the CCP to fully carry out that duty. A CCP’s incentives, however, may not be exactly aligned with the objectives of public policy. Market regulation may be necessary to ensure that policy objectives are taken into account in the design and operation of a CCP. Regulation also may be necessary because of the moral hazard effects that arise from a perception that certain financial market institutions are too big or too interconnected to fail.
In the recent financial crisis, CCPs performed their risk management and operational functions very well. However, some participants in over-the-counter derivatives markets came under severe stress, and some failed specifically because of risk management failures that related to derivatives positions. As a consequence, the leaders of the Group of Twenty (G-20) countries decided to make the central clearing of all standardized OTC derivatives mandatory and to impose higher capital requirements on non-cleared OTC derivatives. The central clearing mandate makes it critical for CCPs to be able to recover from severe financial stresses, such as the default of one or more clearing members. As many observers have noted, CCPs must now be “bulletproof” to avoid the propagation of systemic risk throughout the financial system. But CCPs have not always been bulletproof in the past, and it will be challenging for them to effectively insulate themselves against inherently unpredictable market shocks in the future.

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Chapter 8: Market Participants: Hedgers, Speculators and Arbitrageurs in High Frequency Trading and Price Discovery Futures Markets

The concept of hedging has fundamentally changed the view of futures markets, whose existence was primarily attributed to speculation. Hedging refers to the matching of a risk from holding an asset, whose price fluctuates, with an opposing risk from a futures contract on the same or similar asset. Finance theory indicates that hedging increases firm value by reducing expected taxes, expected costs of financial distress and other agency costs. Often, certain risks are inherent in a business and cannot be eliminated altogether. But identifying those risks and crafting a way to hedge them can reduce the volatility they bring to a company's balance sheet. Theoretical models of hedging and empirical evidence of hedging effectiveness will also be addressed in this chapter. Speculators play a vital role in the futures markets. While futures are designed primarily to assist hedgers in managing their exposure to price risk, this would not be possible without the participation of speculators. Speculators, or traders, assume the price risk that hedgers attempt to lay off in the markets. In other words, hedgers often depend on speculators to take the other side of their trades, and to add depth and liquidity to the markets. Key questions arise as to the role of these market participants in high frequency trading and price discovery, issues of financial stability or instability and implications on society’s welfare.

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Chapter 9: The Fast Track to the Futures: Technological Innovation, Market Microstructure, and the Regulation of High Frequency Trading
As the international financial marketplace has evolved to encompass a wide range of tradable asset classes, tensions between classical investment theory, trading practices, and government regulations have grown. This chapter will map the history of modern trading, taking a close look at the products, venues, and technological underpinnings of today's futures markets. It will focus on High Frequency Trading, assessing the varying roles and needs of investment elites, market makers, regulators, and the public in maintaining clean and orderly market mechanisms. The chapter will conclude with a look ahead in terms of the technology trends and regulatory activities which will shape these mechanisms in the years to come, with comments on market microstructure, the provision of liquidity, and innovation in futures markets around the world.

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Chapter 10: Agricultural Markets

Agricultural futures markets formed the backbone of early futures markets and continue to play an important role in today’s global economy. Since the introduction of non-agricultural futures contracts such as financial and energy products beginning in the 1970s, the relative market size of the agricultural futures in relation to the total volume of futures trading has been decreasing. However, absolute trading volume has continued to grow strongly due to the importance of its traditional price-discovery and risk-transfer functions, and the introduction of agricultural futures markets in other regions, particularly Asia. Furthermore, its uniqueness in addressing such issues as storability, seasonality, cost of carry, quality and location arbitrage, inter-commodity spreads, etc. has made it irreplaceable to various market users. This chapter also introduces the trading strategies that are unique only to agricultural futures by discussing grains (wheat, corn, soybeans), livestock (cattle, hogs, dairy), and soft commodities (cotton, coffee, sugar).

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Chapter 11: Metallurgical Futures Markets

The role of metallurgical markets with an emphasis on gold futures will be discussed in this chapter. Gold has played an historical role as a hedge against inflation. This chapter reviews the industrial organization of the global gold market and evaluates the effectiveness of gold as a hedge against inflation. Other metallurgical commodities will also be studied such as aluminum, copper and nickel.

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Chapter 12: Indices and Index Arbitrage in Futures Markets: Hedge Fund Strategies

Futures Indices are heavily traded futures contracts that include the S&P 500 Index, the Dow Industrials, the NASDAQ 100 and numerous others. Spreading among these indices is a significant amount of volume but both hedging and speculation also play an important role. Furthermore, index arbitrage has been one of the most controversial trading strategies of the 1980s and 1990s. By taking offsetting futures and cash positions, arbitrageurs profit from intermarket prices differences. The apparent feasibility of arbitrage raises, however, the issue of why the same portfolio trades at different prices in different markets. One possible response is to argue that mispricing is less frequent than naïve comparison of cash and index futures prices might suggest and futures price deviations from cost of carry forward prices need not represent true arbitrage opportunities. A second response is to concede that intermarket mispricing is real as a result of noise in the pricing process.

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Chapter 13: Interest Rate Futures

The short-term Euro-dollar and Fed Funds markets and the long-term 10-year note market have huge volumes. Numerous specific financial problems arise in these markets in the traditional areas of hedging, speculation and arbitrage. This chapter reviews these issues and offers a state of the art presentation of the existing techniques. Emphasis is also given to numerous credit risk instruments. The anticipation of Fed policies by Fed Funds futures is also discussed.

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Chapter 14: Foreign Exchange Markets

These markets are currently generating the largest nominal volume and need special emphasis. Issues of trading on fundamentals vs. technical analysis, the role of central banks, the impact of currency crises on banking, financial markets and, possibly the real economy, the role of speculative attacks and other issues will be addressed here. The role of the new Euro will be emphasized and the emerging importance of the renminbi will also be addressed.

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Chapter 15: The European Sovereign Debt Crisis and the Role of Credit Swaps.

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Chapter 16: Energy Futures Markets
The energy futures complex includes several actively traded contracts such as crude oil, gasoline, natural gas, heating oil, gasoline and others. This complex has played an important role recently with the price of crude oil rising to record levels. Price behavior that includes both normal backwardation and contango have been identified in these markets that are characterized by trading activities that extends over long periods of about 10 years into the future.

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**Chapter 17: Climate Futures Contracts**

This chapter will discuss the innovative futures products offered by the Chicago Climate Futures Exchange. Currently, two products are traded based on U.S. Environmental Protection Guidelines: the Sulfur Financial Instrument Futures Contract and the Nitrogen Financial Instrument Futures Contract. The design, pricing, trading volume, hedging and speculation activities and the design of new futures contracts motivated by financial risks arising from violations of environmental guidelines will be addressed.

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**Chapter 18: Weather Derivatives**

The accurate specification of the process that temperature follows over time is a prerequisite for the pricing of temperature derivatives. To this end, we conduct a horse race of alternative specifications of the dynamics of temperature by evaluating their out-of-sample forecasting performance under different evaluation metrics and forecast horizons. We employ an extensive dataset of the daily average temperature measured at different locations in Europe and U.S. We find that a developed principal components model and a combination forecasts model perform best in U.S. and Europe, respectively. We also form point forecasts for popular temperature indices. The results have implications for the pricing and trading of the fast growing class of temperature derivatives, as well as for forecasting temperature.
Chapter 19: Housing Futures Contracts

Even though the market size for residential houses in the U.S. is over $20 trillion and the price volatility has been quite extreme, the housing futures market did not achieve its anticipated trading potential and currently remains at the verge of dissolution. Despite the current lack of trading success, the housing futures market provides a very interesting and important lesson for the new product developers, hedgers, and speculators to know the warning signs of under-performing futures contracts. A few of the reasons that contributed to the lackluster growth of the housing futures market are: the lack of homogeneity in houses; the unidirectional price movements; the complex settlement process; lack of market makers and alternative risk layoff media; etc. There are, however, new attempts to make the housing market more active and tradable by private entities that offer daily house prices based on various statistical models.

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Chapter 20: Electricity Futures

This chapter will describe forwards and futures for electricity currently traded in Europe and other markets. Due to the limited storability and transportability of electricity, spot prices are highly dependent on local supply and demand conditions, business activity, weather conditions. Seasonality is also very strong, during the day (peak vs. off-peak hours), during the week, during cold and hot seasons. As a consequence, liquidity is low and the day-to-day volatility is much higher than in financial markets. We develop the hedging problem for a manufacturer using a given daily amount of electricity for operating his plants and we measure the hedging
performance. A non-negligible effect on good hedging is given by how the spot index for the daily electricity price is calculated.

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Chapter 21: Freight Futures Markets

Forward Freight Agreements or FFAs are future contracts that allow shipping industry participants to trade in future level of freight rates. Freight is a physical commodity that, unlike others, cannot be stored. Therefore, the traditional arbitrage free model cannot be used for freight futures pricing. The pricing method used relies exclusively on the expectation of what the spot (underlying) freight price will be during the time of the settlement and, subsequently, the supply and demand for a contract at a specific price. This chapter aims to give an overview of the development of the freight futures market and describe pricing and trading strategies for hedging the freight exposure both from the shipowners’ and shippers perspective. Given the limited history and depth of the container and tanker freight derivatives market, the focus of this chapter is primarily on the dry bulk futures.

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Chapter 22: Performance of Commodity Futures Funds and Portfolio Theory

There have been numerous extensions of traditional portfolio theory to include not only, stocks, bonds and cash but also, international equities and commodity futures. This chapter will describe the necessary modifications to the theory and the empirical results of a well-diversified portfolio that also includes investment in commodity futures. An overview of the recent performance of futures managed funds will also be included as well as the role of futures positions in hedge funds.

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Chapter 23: Failure of Futures Hedge Funds
This chapter will offer a comprehensive analysis of major futures hedge funds failures such as the classic cases of Long-term Capital Management, the Amaranth Debacle and the recent MF Global case.

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Chapter 24: The Ethics of Financial Speculation in Futures Markets

This article sketches an ethics of financial speculation in futures markets. (1) It identifies an intentionalistic fallacy prevalent in moral criticisms of speculation in general and of financial speculation in particular. (2) It scrutinizes the degree to which the recent debate on financial speculation with agricultural commodities follows the general pattern of moral criticism and its intentionalistic fallacy. (3) It then provides a theoretical and empirical in-depth analysis of long-only index funds engagement in futures markets and concludes that moral criticisms which put them in the pillory as "hungrmakers" are unjust(ied). This proves that ethics, understood as a theory of morality, can criticize moral criticisms of financial speculation on moral grounds. (4) Finally, this article discusses the option of interdisciplinary cooperation between ethics and economics.

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Chapter 25: Macro Risks, Monetary Policy and a Proposal for a Futures Markets contract for Nominal GDP

This chapter will address the current and future macro risks faced by the U.S. and global economy and how existing contracts as well as new futures contracts can help transfer efficiently financial risks that emerge in financial markets, labor markets, housing markets, equity markets and several other macro sources. The central contribution of this chapter is a discussion of various monetary policy paradigms and their impact on analyzing appropriate strategies to address financial crises. The role of the Fed and other central banks during both periods of economic stability as well periods of financial crises will be analyzed. New methods for managing global risks will also be addressed and a proposal for a nominal GDP futures contract will be advanced to argue that futures markets can contribute to a better management of macro-systemic risks.
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