

Quarterly versus Serial Expiration in Pure Cost of Carry Markets: The Case of Single Stock Futures Trading in the U.S.

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In December of 2000, the U.S. Senate passed the Commodity Futures Modernization Act which lifted a moratorium on single stock futures trading enacted by the Shad Johnson Accord. Five months later, the Chicago Mercantile Exchange, the Chicago Board of Trade, and the Chicago Board Options Exchange opted to trade single stock futures in a joint venture called OneChicago. Whereas previously traded stock index futures list only quarterly expiration contracts, OneChicago trades single stock futures with both serial and quarterly expiration dates. We show conceptually that in a pure cost-of-carry market such as single stock futures, there are limited economic benefits to listing serial expiration contracts. We then examine single stock futures trading activity and find that there is a disproportionate share of trading in quarterly expiration contracts.

Introduction

The basis, the difference between the spot price and futures price, is an important pricing relation for all futures market participants. For many futures markets, the

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basis represents the cost of carrying the underlying asset forward for delivery against the short position. Absent seasonality, the convenience yield, timing options, or quality issues, the basis in a pure cost-of-carry market represents any storage fees plus the opportunity cost of capital. For most financial futures, storage fees are presumed equal to zero, and thus the basis simply represents the time value of money.

One example of a pure cost-of-carry market is single stock futures which has both quarterly and serial contracts listed in the United States. Quarterly contracts expire in March, June, September, and December, while serial contracts expire in one of the remaining months. If the single stock futures basis only reflects the time value of money, there may be limited economic merit in listing serial month contracts in addition to quarterly expirations. In this paper, we review the history of single stock futures in the United States, discuss trading implications of the contract's specifications, and then examine the empirical evidence of the first exchange listed contracts.

The evolution of single stock futures trading in the United States is similar to the beginning of a number of other new derivatives, alternative risk transfer instruments, exchange-traded funds, and variants of tax-deductible equity. The need for financial innovation arises when market imperfections such as taxes, regulation, information asymmetries, transaction costs, and moral hazard affect trading (Tufano, 2003). Moreover, financial innovation is designed to help society reallocate risk, reduce agency costs, and increase liquidity in financial markets associated with these costs. If the world were free of all imperfections, then financial innovations would benefit neither private parties nor society and simply would be neutral mutations (Miller, 1977).

While one innovation, stock index futures, has traded successfully in the US for more than 20 years, jurisdiction conflicts between the Security Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC) led to a ban of single stock futures for much of the period. The SEC vetoed single stock futures trading due to concerns about the effects in the underlying equity market. Moreover, the SEC claimed that futures on individual stocks are equities themselves and therefore should be regulated as equities. In opposition, the CFTC argued that single stock futures are no different than other futures written on commodities and fixed income securities and thus need no additional oversight. This conflict of interest between the regulatory agencies led to the Shad-Johnson Accord which placed a moratorium on trading of single stock futures contracts.

In December 2000, the CFTC and the SEC signed the Commodity Futures Modernization Act (CFMA) which lifted a 20 year moratorium on single stock futures. Under the CFMA, the CFTC maintains exclusive jurisdiction over broad-based indexes, but now the CFTC and SEC jointly regulate narrow-based indexes and single stock futures. After negotiating terms and regulations, two exchanges, OneChicago and NQLX, began trading single stock futures in November 2002.

OneChicago is a joint venture between the Chicago Mercantile Exchange, the Chicago Board of Trade, and the Chicago Board of Options Exchange, and it now lists all single stock futures contracts in the United States after the NQLX ceased trading activity in October 2004.

For a financial innovation to be more than a neutral mutation of existing instruments, it must provide economic value to at least some of the potential users. Ang and Cheng (2005) posit that single stock futures have at least two main advantages over the trading of stocks and other available equity derivatives. First, the contract enables investors to circumvent short-selling constraints in the market. By selling a single stock futures contract, it is now possible to directly short the underlying security. A second advantage is that single stock futures have lower margin requirements (20 percent versus 50 percent in the equity market) and thereby give investors a position with greater leverage in the stock. Ang and Cheng further note that both advantages are important to arbitrageurs as well as hedgers. They find that the introduction of single stock futures trading has a stabilizing effect on prices and thus leads to gains in market efficiency.

Despite the findings of Ang and Cheng, the single stock futures market has enjoyed only a small degree of success in the United States. Johnson (2005) believes that the lukewarm reception is in large part a function of overregulation. He suggests that a margin of 5 percent similar to other futures contracts would be more appropriate than the 20 percent requirement championed by the SEC. Johnson's call for lower margins echoes the position of Dutt and Wein (2003) who propose a risk-based margin requirement. Even with lower margin requirements, however, Johnson is not certain that would be enough to overcome co-regulatory issues or the mistakes made in structuring the market.

Jones and Brooks (2005) cite additional reasons for low trading activity of single stock futures. Unfavorable tax laws or investor unfamiliarity are two possible explanations for low volume. They also believe that single stock futures as a hedging tool may be too expensive, given the market's lack of liquidity. Jones and Brooks note that "(H)edgers and large speculators cannot effectively trade in a market where the total yearly volume is so far below that of the average daily volume in the underlying security." They conclude that future research should examine specific uses of single stock futures and whether hedgers or speculators are the primary market participants. Additionally, Jones and Brooks call for a further examination of contract specification features that either attract or deter investors.

In the subsequent analysis, we consider the uses of single stock futures by hedgers and arbitrageurs. We show that in a pure cost-of-carry environment, there are few economic benefits for either type investor from listing serial month contracts in addition to quarterly expirations. On the other hand, further segmenting the market lowers liquidity for any given expiration, thereby increasing transaction costs. Whether the listing of both serial and quarterly expiration contracts yields positive

net benefits to the investor is largely an empirical issue. Therefore, we examine the early trading history of single stock futures and discuss the empirical implications of their investment use.

Economics of Trading Futures under the Cost of Carry Model

While single stock futures contracts have enhanced investors' abilities to reallocate risk, smooth consumption, and reduce agency costs, they have enjoyed only limited success in the United States. Some believe that unfavorable tax laws, high margin requirements, or investor unfamiliarity explain low volume. Additionally, single stock futures as a hedging tool may be too expensive given the market's lack of liquidity (Jones and Brooks, 2005). In this section, we consider whether there are additional net benefits to investors from listing serial month contracts in a pure cost-of-carry market.

To determine the effectiveness of a futures hedge, investors in general must analyze and model the stochastic factors influencing the behavior of the underlying asset and its associated futures contract. In all cases, the nature of this relation is market specific. Investors looking to protect positions in commodities, for example, must consider the influence of seasonal weather patterns when making their hedging strategy. Oil market participants, on the other hand, also must consider how shifts in inventories and convenience yields impact both spot and futures prices. In Treasury bond futures, pricing factors include the cheapest bond to deliver and the wild card option.

In a pure cost-of-carry market, however, seasonality, convenience yield factors, and quality or timing issues are not relevant for the pricing of futures contracts. One such market is single stock futures and, as OneChicago states, prices should equal their net cost of carry value. From this relation, it necessarily follows that in a pure cost-of-carry market, the stochastic process of the futures contract is driven solely by the dynamics of the underlying asset.

For hedgers, a second implication of a pure cost-of-carry market is that it is possible to construct a portfolio of the futures and underlying asset that has zero variance over the hedge horizon. While selection of the futures' expiration will affect the hedge ratio, and therefore the number of contracts to use, it will not influence hedging effectiveness. In all cases, the perfectly hedged portfolio will earn the riskless (net) cost of carry return. A formal proof of this appears in a separate appendix.

The concern of arbitrageurs is the ability to buy and sell in a relatively short period of time in order to profit from potential pricing irregularities or beliefs about future price movements in the equity market. In futures markets where quality differences, convenience yields, or timing options influence futures prices beyond uncertainty in the underlying asset, different profit opportunities may exist across the listed futures contracts. In a pure cost-of-carry market, however, no such differences exist.

Similar to hedging, a pure cost-of-carry market implies that the return to an arbitrageur's strategy is independent of the futures' expiration month that is selected. A formal proof is left to the appendix. Moreover, a further implication of this result is that the arbitrageur will prefer to trade in the contract with the greatest amount of liquidity, because these markets provide the lowest transaction costs.

The previous analysis argues that both hedgers and speculators potentially would benefit from a reduction in the number of listed single stock futures expiration months. Decreasing the number of listed expirations should increase market liquidity and lower trading costs. Assuming greater volume per contract and lower spreads, informed traders will be attracted to the futures market and overall trading activity will increase, a result consistent with the observation of Shastri, Thirumalai, and Zutter (2006). They base their conclusion on regressions that find information content in single stock futures prices is negatively related to spreads and positively related to single stock futures volume.

One exception to the foregoing analysis is potential arbitrage activity between single stock futures and listed options. Given that the latter expire every month, traders may find it efficient to arbitrage between futures and options with the same serial expiration date. One benefit is that a dividend surprise would affect both derivatives in the same way, thus immunizing any arbitrage activity from the economic innovation.

The decision for which contracts to offer is mainly an empirical question. For many investors, their portfolio is marked to market on a quarterly basis, and they may be inclined to use quarterly month expirations. Moreover, stock index futures only expire quarterly, and arbitrage opportunities might further drive interest in quarterly single stock futures contracts. The one argument for listing serial dates is to exploit single stock futures and options arbitrage opportunities.

In other financial futures markets, contracts are limited to quarterly expirations. Beside the previously mentioned stock index futures, examples of pure cost-of-carry markets with only quarterly expirations include foreign exchange and Treasury futures contracts. Given limited benefits to listing serial expiration dates, the question becomes whether single stock futures trading will migrate to the more liquid contracts. To see if market participants self-select to a particular expiration, we analyze the single stock futures trading activity for contracts listed on OneChicago.

Trading Activity of Single Stock Futures Futures Data

The data for this study consist of daily trading frequency, daily trading volume, and daily open interest for all contracts listed and traded on OneChicago from November 8, 2002 and December 31, 2004. We obtained these data from the OneChicago web site and screened the records for any obvious outliers. To study the trading activity of single stock futures contracts, the data for each contract are parti-

tioned according to a rolling date to maturity. Thus, expiration 1 is the nearby contract and is the single stock futures contract closest to expiry. Expiration 2 is the next expiration contract, and so forth. If, for example, expirations 1, 2, and 3 are January, February, and March, as the January contract expires, February and March become expirations 1 and 2. An already listed June contract becomes expiration 3.

In the beginning of our sample period, contract expirations included two serial months and two quarterly months. After July 2004, OneChicago changed listings to include up to two serial month expirations and three quarterly expirations. Throughout the entire sample period, expiration 4 always has been a quarterly month contract.

In addition to analyzing all single stock futures trading, we examine the trading activity for the 20 most active single stock futures contracts. Table 1 presents these firms, the number of trading days the contracts were listed, and the number of days that the contracts traded. The list represents the 20 firms that had the highest number of days where at least one contract traded. In all 20 cases, trading occurred in at least 87 percent of all days that the contract was listed. These firms are mainly concentrated in the high tech sector and, as a consequence of our selection criteria, first were listed on or near November 8, 2002, the start of single stock futures trading at OneChicago.

Table 1—20 Most Active Contracts

The following table summarizes the 20 most actively traded companies as measured by total number of days at least one of the firm's contracts has traded

Company Name	Stock Symbol	SSF	Beginning Date	Ending Date	Trading Days	No. of Days any Contract Traded
Applied Materials Inc.	AMAT	AMAT1C	11/22/02	12/31/04	530	478
Amgen Inc.	AMGN	AMGN1C	11/22/02	12/31/04	530	510
Broadcom Corp. - CLA	BRCM	BRCM1C	12/12/02	12/31/04	517	474
Cisco Systems Inc.	CSCO	CSCO1C	11/22/02	12/31/04	530	493
Dell Inc.	DELL	DELL1C	11/08/02	12/31/04	540	485
eBay Inc.	EBAY	EBAY1C	11/22/02	12/31/04	530	526
IBM Corp.	IBM	IBM1C	11/22/02	12/31/04	530	468
Intel Corp.	INTC	INTC1C	11/22/02	12/31/04	530	490
KLA-Tencor Corp.	KLAC	KLAC1C	12/05/02	12/31/04	522	512
Microsoft Corp.	MSFT	MSFT1C	11/08/02	12/31/04	540	492
Maxim Integrated Products Inc.	MXIM	MXIM1C	11/22/02	12/31/04	530	522
Newmont Mining Corp Hldg Co.	NEM	NEM1C	12/05/02	12/31/04	522	468
NVIDIA Corp.	NVDA	NVDA1C	12/05/02	12/31/04	522	459
Novellus Systems Inc.	NVLS	NVLS1C	12/12/02	12/31/04	517	449
QUALCOMM Inc.	QCOM	QCOM1C	11/08/02	12/31/04	540	531
QLogic Corp.	QLGC	QLGC1C	11/22/02	12/31/04	530	494
SanDisk Corp.	SNDK	SNDK1C	11/22/02	12/31/04	530	488
Symantec Corp.	SYMC	SYMC1C	12/12/02	12/31/04	517	461
Xilinx Inc.	XLNX	XLNX1C	12/12/02	12/31/04	517	455
Yahoo! Inc.	YHOO	YHOO1C	01/21/03	12/31/04	492	480

Empirical Evidence

Table 2 displays descriptive statistics for the daily trading frequencies of every single stock futures contract traded on OneChicago. Initially, OneChicago started trading with 21 single stock futures contracts. At the end of the sample, the total number of ever-traded contracts grew to 128. Contracts listed at the launch of OneChicago have a maximum of 540 possible trading days. The average number of trading days available for all contracts in our sample is 388 days, while the minimum number of days a contract was listed is 4.

Table 2—Trading Frequencies of Single Stock Futures, All Contracts

This table displays the descriptive statistics for trading frequencies of all single stock futures contracts traded on OneChicago. Contract maturities are partitioned into the first four expirations, where expiration 1 is the nearby contract, expiration 2 is the next expiration, etc. Initially, the expirations for all contracts included two serial months and two quarterly expirations. After July 2004, listings were changed to include up to two serial month expirations and three quarterly expirations. Expiration 4 is always a quarterly month throughout the sample. There were 128 contracts on 124 firms that ever traded between November 8, 2002 and December 31, 2004. The table reports the maximum, minimum, and average number of days that an expiration traded across the 128 contracts. The final column represents the percentage (%) of days a given expiration traded. The final column also reports the split of an expiration's trading frequency between quarterly and serial months

	Maximum	Minimum	Median	Average	% Days Traded Qtr/Ser Split
Number of Trading Days for Each Contract	540	4	517	388	
Number of Days Expiration 1 Traded	501	0	184	187	48
Days Expiration 1 is Quarterly Month	193	0	163	130	
Days Expiration 1 is Quarterly and Traded	189	0	71	74	39
Days Expiration 1 is Serial Month	359	0	347	258	
Days Expiration 1 is Serial and Traded	335	0	106	113	61
Number of Days Expiration 2 Traded	414	0	122	134	35
Days Expiration 2 is Quarterly Month	186	0	186	136	
Days Expiration 2 is Quarterly and Traded	182	0	64	67	50
Days Expiration 2 is Serial Month	354	0	331	251	
Days Expiration 2 is Serial and Traded	234	0	58	67	50
Number of Days Expiration 3 Traded	370	0	72	86	22
Days Expiration 3 is Quarterly Month	261	0	249	197	
Days Expiration 3 is Quarterly Month and Traded	206	0	49	61	71
Days Expiration 3 is Serial Month	291	0	261	190	
Days Expiration 3 is Serial and Traded	164	0	17	25	29
Number of Days Expiration 4 Traded	309	0	48	68	17
Days Expiration 4 is Quarterly Month	540	4	517	388	
Days Expiration 4 is Quarterly and Traded	309	0	48	68	100

Looking across all contracts, we find the greatest trading activity occurs in the nearby contract, expiration 1. For the 128 companies, expiration 1 traded a maximum of 501 days and the average number of days is 187. In contrast, expirations 2, 3, and 4 traded a maximum of 414, 370, and 309 days and, on average, 134, 86, and 68 days, respectively. Furthermore, in terms of the percentage of days a given expiration traded (the last column in Table 2), expiration 1 traded 48 percent of the time followed by expirations 2, 3, and 4 at 35 percent, 22 percent, and 17 percent.

To get a handle on the relative trading frequency between serial and quarterly months, we first must adjust for the difference in the number of possible trading days in each. Consider expirations 1 and 2. Both have approximately twice as many possible trading days with a serial month expiration as a quarterly month expiration. A naïve expectation is the trading frequency for serial month expiration relative to a quarterly month expiration would be two to one. In fact, for expiration 1, the split in trading frequency is 61 percent in the serial month and 39 percent in the quarterly month maturity. For expiration 2, actual trading is split nearly 50-50 between quarterly and serial months. For expiration 3, the available trading days for quarterly and serial month expirations are divided evenly due to the July 2004 listing changes at OneChicago. Nevertheless, the trading frequency is concentrated in the quarterly month expiration (71 percent). In all cases, after taking into account possible trading day differences, the relative frequency of trades is more heavily weighted toward the quarterly month expirations.

In addition to examining the trading patterns for all contracts listed on OneChicago, we also look at the trading activity for the 20 most actively traded single stock futures contracts (Table 1). Table 3 shows trading patterns for the 20 most active contracts are similar to those of our entire sample. In particular, we find that expiration 1 trades roughly 77 percent of the available trading dates, followed by the 2, 3, and 4 expiration contracts at 60 percent, 43 percent, and 34 percent, respectively. Furthermore, we also find that the proportion of trading frequency favors the quarterly month once we've adjusted for differences in possible trading days. That is, 38 percent of expiration 1 trades are quarterly maturities even though they constitute only 33 percent of all expiration 1 trading days. For expiration 2, the frequency is split nearly 50-50, while expiration 3 has two thirds of its trading frequency occur when there is a quarterly month maturity. These trading patterns seem to indicate that investors are self-selecting and prefer to trade single stock futures contracts with quarterly month expirations.

The bias toward quarterly month trading is even more noticeable if we consider single stock futures volume. Table 4 shows descriptive statistics for the trading volume of all single stock futures contracts listed on OneChicago. Over the sample time period, we find that the nearby contract is the most heavily traded expiration. For one company, its nearby futures had trading volume of 114,746 contracts, while the average company had expiration 1 volume of 10,548 contracts. In terms of total trading

volume, expiration 1 represents 39 percent of all single stock futures volume. In comparison, expirations 2, 3, and 4 constitute 21 percent, 15 percent, and 25 percent of total trading volume, respectively. Of particular note is that expiration 4, which is always a quarterly month, has a higher percentage of total trading volume than either expiration 2 or 3.

Table 3—Trading Frequencies of Single Stock Futures, 20 Most Active Contracts

This table displays the descriptive statistics for trading frequencies of the 20 most active single stock futures contracts (firms) traded on OneChicago. Contract maturities are partitioned into the first four expirations, where expiration 1 is the nearby contract, expiration 2 is the next expiration, etc. Initially, the expirations for all contracts included two serial months and two quarterly expirations. After July 2004, listings were changed to include up to two serial month expirations and three quarterly expirations. Expiration 4 is always a quarterly month throughout the sample. The sample includes single stock futures contracts traded between November 8, 2002 and December 31, 2004. The table reports the maximum, minimum, and average number of days that an expiration traded across the 20 firms. The final column represents the percentage (%) of days a given expiration traded. The final column also reports the split of an expiration's trading frequency between quarterly and serial months

	Maximum	Minimum	Median	Average	% Days Traded Qtr/Ser Split
Number of Trading Days for Each Contract	540	492	530	526	
Number of Days Expiration 1 Traded	501	328	384	403	77
Days Expiration 1 is Quarterly Month	193	163	183	177	
Days Expiration 1 is Quarterly and Traded	189	122	154	153	38
Days Expiration 1 is Serial Month	359	329	347	350	
Days Expiration 1 is Serial and Traded	335	201	239	250	62
Number of Days Expiration 2 Traded	414	220	300	314	60
Days Expiration 2 is Quarterly Month	186	186	186	186	
Days Expiration 2 is Quarterly and Traded	182	116	145	146	47
Days Expiration 2 is Serial Month	354	306	344	340	
Days Expiration 2 is Serial and Traded	234	104	157	168	53
Number of Days Expiration 3 Traded	370	143	213	224	43
Days Expiration 3 is Quarterly Month	261	231	249	251	
Days Expiration 3 is Quarterly Month and Traded	206	89	152	147	66
Days Expiration 3 is Serial Month	291	261	281	275	
Days Expiration 3 is Serial and Traded	164	29	66	77	34
Number of Days Expiration 4 Traded	309	107	181	183	34
Days Expiration 4 is Quarterly Month	540	492	530	526	
Days Expiration 4 is Quarterly and Traded	309	107	181	183	100

Dichotomizing the trading volume of the specific expirations into the serial and quarterly months, we find a majority of the volume occurs when there is a quarterly expiration date. The relative concentration of quarterly trading volume is 72 percent,

78 percent, 89 percent, and 100 percent for expirations 1, 2, 3, and 4, respectively. These findings illustrate that investors strongly prefer quarterly month expirations. Coupled with the trading frequency results, the evidence supports a selectivity bias in favor of quarterly expiration contracts.

Table 4—Trading Volume of Single Stock Futures – All Contracts

This table displays the descriptive statistics for trading volume of all single stock futures contracts traded on OneChicago. Contract maturities are partitioned into the first four expirations, where expiration 1 is the nearby contract, expiration 2 is the next expiration, etc. Initially, the expirations for all contracts included two serial months and two quarterly expirations. After July 2004, listings were changed to include up to two serial month expirations and three quarterly expirations. Expiration 4 is always a quarterly month throughout the sample. There were 128 contracts on 124 firms that ever traded between November 8, 2002 and December 31, 2004. The table reports the maximum, minimum, and average volume for each expiration across the 128 contracts. The final column represents each expiration's volume as a percentage (%) of total volume. The final column also reports the split of an expiration's volume between quarterly and serial months

	Maximum	Minimum	Median	Average	% of Tot Vol Qtr/Ser Split
Total Volume Traded for all Contracts	256,031	0	23,126	27,269	
Total Volume Traded for Expiration 1 Contract	114,746	0	9,154	10,548	39
Volume when Expiration 1 is Quarterly Month	57,046	0	6,253	7,577	72
Volume when Expiration 1 is Serial Month	57,700	0	1,645	2,970	28
Total Volume Traded for Expiration 2 Contract	60,670	0	4,559	5,771	21
Volume when Expiration 2 is Quarterly Month	43,674	0	3,380	4,504	78
Volume when Expiration 2 is Serial Month	16,996	0	663	1,266	22
Total Volume Traded for Expiration 3 Contract	61,041	0	2,338	3,992	15
Volume when Expiration 3 is Quarterly Month	50,646	0	2,063	3,562	89
Volume when Expiration 3 is Serial Month	10,395	0	115	429	11
Total Volume Traded for Expiration 4 Contract	25,876	0	5,717	6,957	25

Looking at the 20 most active single stock futures contracts in Table 5, we find they exhibit similar trading volume patterns to the entire sample. That is, expiration 1, on average, has the greatest amount of trading volume and represents 42 percent of the total trading volume of the 20 most active firms. Expirations 2, 3, and 4 constitute 22 percent, 18 percent, and 18 percent of the total volume. Breaking down activity between serial and quarterly months, we see that expirations 1, 2, and 3 have a majority of their trading volume occur (58 percent, 68 percent, and 85 percent, respectively) when there is a quarterly month maturity.

To see whether volume differences between quarterly and serial expirations are statistically significant, we consider all single stock futures contracts that traded for

at least 65 days in our sample period. This ensures a rotation through expiration months so that contracts 1, 2, and 3 have a serial and quarterly expiration at some point in time. Table 6 reveals that when contract 1 is a quarterly expiration, average daily volume is nearly five times greater than when it is a serial month. Testing for difference in means, the Behrens-Fisher *t* statistic implies that we can reject the null hypothesis of quarterly expiration volume equal to serial expiration volume at the 1 percent significance level. Similarly, for contracts 2 and 3, average daily volume of the quarterly contract is, respectively, seven and six times larger than the serial contract. In both cases, the results are significant at the 1 percent level.

Table 5—Trading Volume of Single Stock Futures, 20 Most Active Contracts

This table displays the descriptive statistics for trading volume of the 20 most active single stock futures contracts traded on OneChicago. Contract maturities are partitioned into the first four expirations, where expiration 1 is the nearby contract, expiration 2 is the next expiration, etc. Initially, the expirations for all contracts included two serial months and two quarterly expirations. After July 2004, listings were changed to include up to two serial month expirations and three quarterly expirations. Expiration 4 is always a quarterly month throughout the sample. The sample includes single stock futures contracts traded between November 8, 2002 and December 31, 2004. The table reports the maximum, minimum, and average volume for each expiration across the 20 firms. The final column represents each expiration's volume as a percentage (%) of total volume. The final column also reports the split of an expiration's volume between quarterly and serial months

	Maximum	Minimum	Median	Average	% of Tot Vol Qtr/Ser Split
Total Volume Traded for all Contracts	256,031	19,739	44,760	56,533	
Total Volume Traded for Expiration 1 Contract	114,746	8,817	18,018	23,639	42
Trading when Expiration 1 is Quarterly Month	57,046	5,411	10,956	13,771	58
Trading when Expiration 1 is Serial Month	57,700	3,362	6,276	9,868	42
Total Volume Traded for Expiration 2 Contract	60,670	3,199	9,058	12,480	22
Trading when Expiration 2 is Quarterly Month	43,674	1,786	6,428	8,454	68
Trading when Expiration 2 is Serial Month	16,996	1,389	2,867	4,026	32
Total Volume Traded for Expiration 3 Contract	61,041	2,751	7,211	10,316	18
Trading when Expiration 3 is Quarterly Month	50,646	2,251	6,214	8,730	85
Trading when Expiration 3 is Serial Month	10,395	199	749	1,586	15
Total Volume Traded for Expiration 4 Contract	20,748	2,676	8,971	10,099	18

Finally, Figures 1 and 2 show the time-to-maturity trading patterns for the average daily trading volume and the average daily open interest. The figures illustrate the differences between quarterly and serial month maturities. Expiration 1's daily trading volume and open interest is, on average, three times and nine times greater for the quarterly month compared to the serial month maturity. Similarly, expiration

2's daily trading volume and open interest is, on average, five times and ten times greater when it has a quarterly expiration month.

Table 6—Average Daily Trading Volume of Quarterly vs. Serial Contracts

The null hypothesis is that for expiration i ($i = 1, 2, 3$), the average volume of quarterly expiration contracts equals the average volume of serial expiration contracts. All tests are based on the 121 single stock futures contracts that have traded for at least 65 days (approximately three months)

t-Test: Two-Sample Assuming Unequal Variances

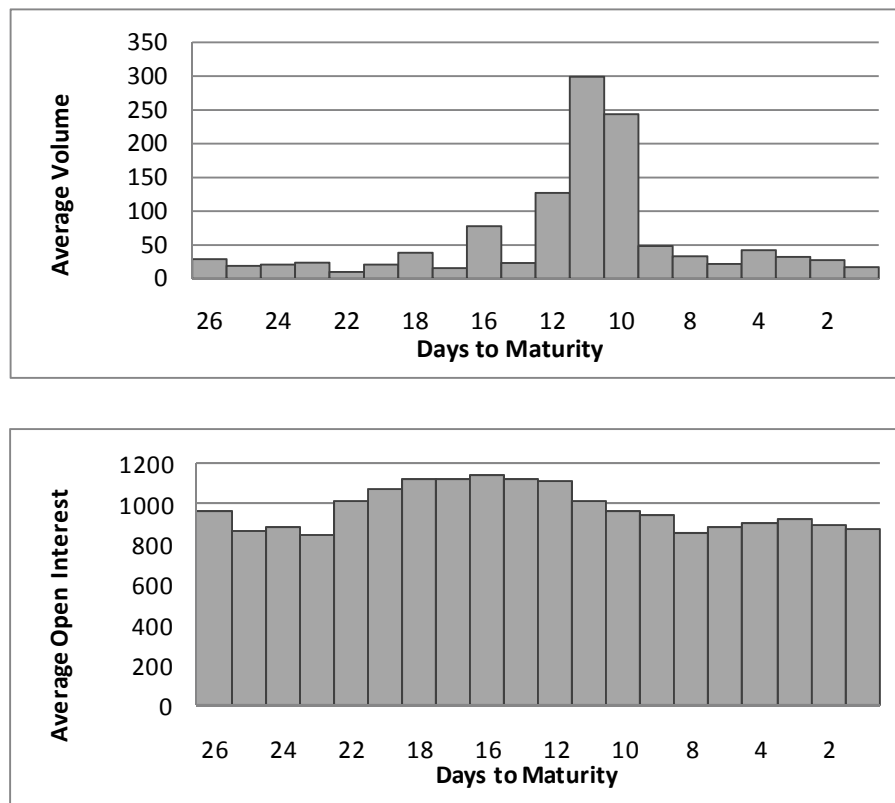
Expiration 1 Contracts	Quarterly	Serial
Mean	53.13058155	11.20288189
Variance	2059.484523	340.2267035
Observations	121	121
Hypothesized Mean Difference	0	
Df	159	
t Stat	9.414867867	
$P(T \leq t)$ two-tail*	0.000000000	
Expiration 2 Contracts	Quarterly	Serial
Mean	29.55994888	4.331031742
Variance	961.9732309	36.99431417
Observations	121	121
Hypothesized Mean Difference	0	
Df	129	
t Stat	8.780426384	
$P(T \leq t)$ two-tail*	0.000000000	
Expiration 3 Contracts	Quarterly	Serial
Mean	17.08116712	2.903400682
Variance	727.8515212	46.53738213
Observations	121	121
Hypothesized Mean Difference	0	
Df	135	
t Stat	5.604294412	
$P(T \leq t)$ two-tail*	0.000000113	

*All three contracts reject the null hypothesis that the average volume of quarterly expiration contracts equals the average volume of serial expiration contracts at the .01 significance level

Figures 1 and 2 together also yield some insight into whether investors use serial month expirations to hedge their positions. If the serial month expirations are important for hedging, we should expect to see some roll over from the expiration 1, quarterly month into the expiration 2, serial month during the last two weeks of trading. This does not occur. The daily open interest in the nearby, quarterly month expiration falls approximately 150 contracts between day 12 and day 8 (Figure 1). There is no corresponding spike in the expiration 2, serial month open interest between days 12 and 8 (Figure 2). Thus, the decline in expiration 1, quarterly month open interest two weeks before maturity is mainly due to investors closing out their positions. Nevertheless, what is striking about the open interest for the quarterly month expiration is that it remains fairly stable over the last two months of trading, staying mostly in a band between 800-1000 contracts. Even on the final day of trad-

Figure 1—Time to Maturity Patterns of Average Daily Trading Volume and Open Interest for the Nearby Contract with Quarterly and Serial Month Expirations

Quarterly

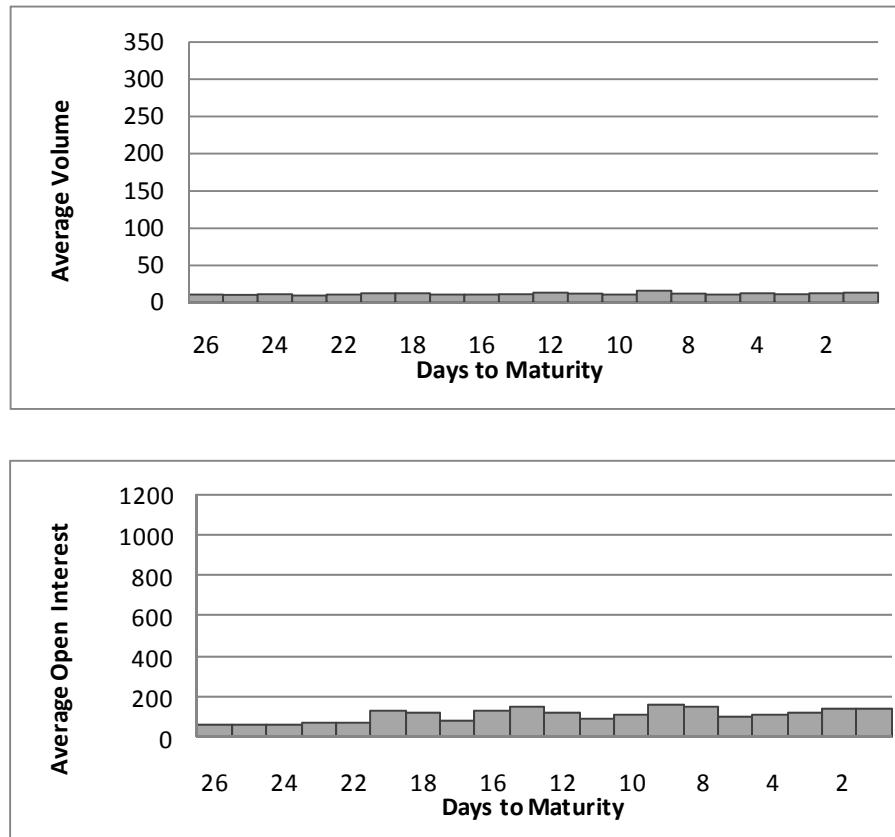


ing, open interest remains at more than 800 contracts and suggests that investors use single stock futures contracts mainly to take delivery at the end of the quarter.

This result is consistent with investors wanting to use single stock futures contracts to help manage their portfolio and mark to market their position on a quarterly basis. The delivery aspect of single stock futures helps to explain why there are multiple quarterly expirations. After all, if multiple expirations are economically redundant, it would make sense to only list one. If investors use single stock futures contracts as a way to inventory the underlying stock, then multiple expirations allow for a cheaper method to take delivery of shares on a more frequent basis. Given the market's revealed preference of quarterly over serial expirations, one possibility might be to list a short-term quarterly contract and (initially) a long-term quarterly contract. Similar to the options market that includes LEAPs (long-term options), as time moves forward, the long-term futures contract eventually would become the nearby contract and a new, long-term futures contract then would be listed.

Figure 1 (cont.)—Time to Maturity Patterns of Average Daily Trading Volume and Open Interest for the Nearby Contract with Quarterly and Serial Month Expirations

Serial



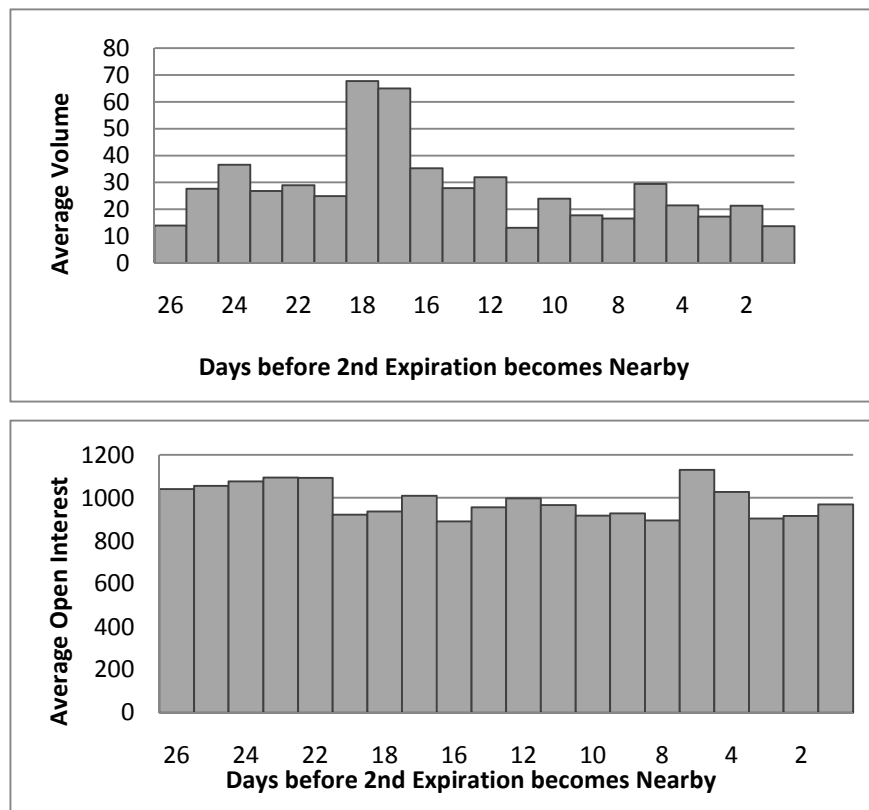
Conclusions

After a longstanding regulatory disagreement between the SEC and CFTC, Congress passed the Commodity Futures Modernization Act in 2000 that included legislation for the trading of single stock futures contracts in the United States. Two years later, two exchanges, OneChicago and the NQLX, began trading the first single stock futures contracts. Despite the long awaited start-up, single stock futures have failed to achieve the earlier trading success of stock index futures and other related financial derivatives.

Generally speaking, new derivative products are successful if they somehow add value. This can occur if they help complete the market, offering investors new risk and return opportunities, or if they enable financial transactions that are more economically efficient. If the derivative is merely a neutral mutation, it adds no benefits

Figure 2—Time to Maturity Patterns of Average Daily Trading Volume and Open Interest for the Two-Month Contract with Quarterly and Serial Month Expirations

Quarterly

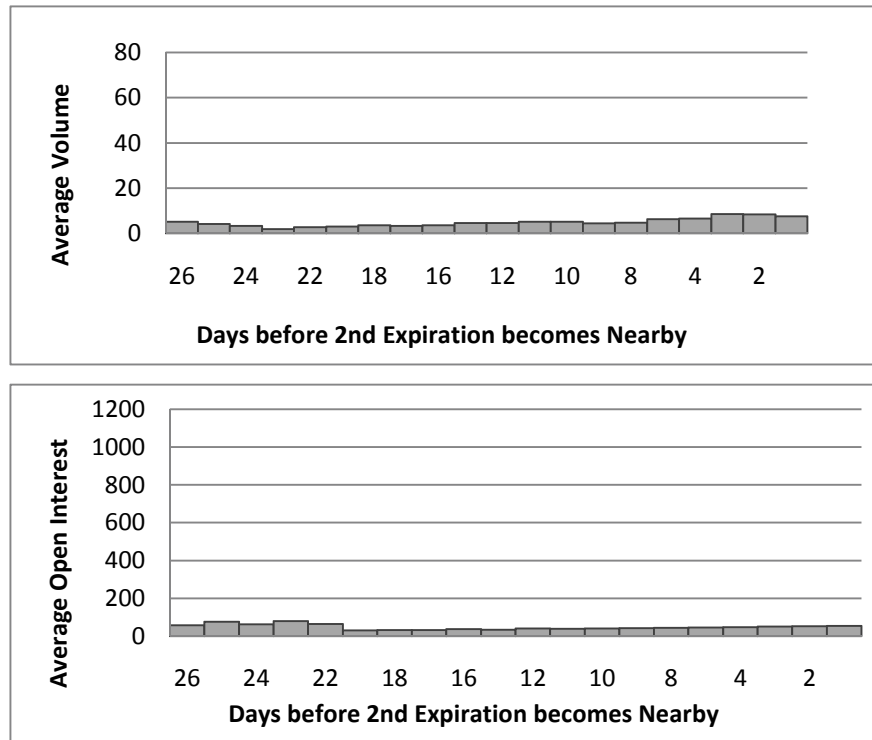


to private parties or society and will fail in the marketplace. In the case of single stock futures contracts, Ang and Cheng (2005) note the two main advantages over trading stocks are the lower costs of taking a short position in the equity and the lower margin requirements. Nevertheless, the early results suggest that these two relative advantages are not enough to encourage many potential investors to trade single stock futures.

Jones and Brooks (2005) believe that a primary reason for the lack of trading is that single stock futures as a hedging instrument may be too expensive, given the market's lack of liquidity. In their work, they call for further research to determine whether hedgers or speculators are the primary market participants. In our analysis, we demonstrate that in a pure cost-of-carry market, hedgers are indifferent to a contract's expiration month. Once they choose a contract expiration, it is possible to

Figure 2 (cont.)—Time to Maturity Patterns of Average Daily Trading Volume and Open Interest for the Two-Month Contract with Quarterly and Serial Month Expirations

Serial



determine the optimal hedge ratio and completely eliminate portfolio risk. From the viewpoint of the speculator, contract expiration also is of no consequence. In a pure cost of carry, gross returns in the futures market are independent of the expiration month.

While single stock futures represent a pure cost-of-carry market, one possible benefit of listing serial month expiration dates is to promote arbitrage activity between futures and option contracts. Traders, however, always can RFQ (request for quote) and negotiate delivery of the underlying stock prior to expiration. This opportunity provides an alternative delivery method of the underlying and mitigates the marginal benefit of listing serial month futures contracts to arbitrage against options.

Ultimately the net benefit of trading both serial and quarterly expiration month contracts in a pure cost-of-carry market is an empirical issue. In the case of single stock futures, the evidence shows that investors already self-select and mainly use the quarterly month contracts. The results suggest that, for the most part, investors use single stock futures contracts to manage their portfolio and take delivery of stock

on a quarterly basis. Thus, one implication of our analysis is for OneChicago to eliminate listing of serial month contracts. This will have the benefit of increasing liquidity for individual contracts with little loss in economic welfare.

Even if the exchange reduces the number of listed expiration dates, the marginal effect on overall volume may be small, given our documentation of selectivity bias exhibited by traders. In the end, the success of the single stock futures market depends upon its relative advantage over other investment opportunities. If the predominant use of single stock futures contracts is to manage equity portfolios, almost certainly regulators must allow risk-based margin requirements and lower margins from their current 20 percent level.

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Appendix

Hedging Effectiveness and Contract Expiration

Here we formally show that hedging effectiveness is independent of the futures contract expiration date in a pure cost-of-carry market. To begin, consider the hedger at time t who wishes to minimize the variance of a portfolio consisting of a predetermined cash market position, S_t , and a position in h_t futures contracts that expire at time T . Lifting the hedge after k days yields a portfolio value:

$$P_{t+k} = S_{t+k} + h_t \Delta F_t, \quad (1)$$

where ΔF_t equals the difference between the futures price at the end of the hedge period and the initial futures price, $F_{t+k,T} - F_{t,T}$. The conditional variance of the portfolio's cash flow given all information up to date t is

$$\text{Var}_t^*(P_{t+k}) = \text{Var}_t^*[S_{t+k}] + h_t^2 \text{Var}_t^*[\Delta F_t] + 2h_t \text{Cov}_t^*[\Delta F_t, S_{t+k}], \quad (2)$$

and it follows that the optimal risk minimizing hedge ratio is

$$h^* = -\frac{\text{Cov}_t^*[F_{t+k,T}, S_{t+k}]}{\text{Var}_t^*[F_{t+k,T}]}. \quad (3)$$

In turn, equation (3) implies the variance of the hedge portfolio is a function of the underlying asset's price volatility and the correlation between the underlying asset and the futures contract,

$$\text{Var}_t^*(P_{t+k}) = \text{Var}_t^*[S_{t+k}] - \rho_{F,S}^2 \text{Var}_t^*[S_{t+k}]. \quad (4)$$

If the two securities are perfectly correlated, (4) implies that the optimal hedging strategy will eliminate all risk from the hedger's portfolio.

For single stock futures, prices equal their net cost of carry value:

$$F_{t,T} = S_t \exp(\phi\tau), \quad (5)$$

where ϕ represents the net cost of carry (interest minus dividends) and τ equals the number of days to expiration in the futures contract ($= T - t$). This pricing relation parallels the derivation in Chance (2006) and further implies the convergence of spot and futures prices at expiration. If futures only reflect carrying costs, the risk minimizing hedge ratio in (3) then reduces to:

$$\begin{aligned} h_t^* &= -\frac{\text{Cov}_t^*[F_{t+k,T}, S_{t+k}]}{\text{Var}_t^*[F_{t+k,T}]}, \\ &= -\exp\{-\phi\tau_{t+k}\}. \end{aligned} \quad (6)$$

Under the cost of carry assumption, the hedge ratio should equal the negative of the $t+k$ price of a pure discount bond that matures on the futures contract expiration date (either a serial or quarterly month) and yields the net cost of carry. This hedge ratio selection rule would eliminate all portfolio risk. That is,

$$\text{Var}_t^*[P_{t+k}] = \text{Var}_t^*[S_{t+k}] - \frac{(\text{Cov}_t^*[F_{t+k,T}, S_{t+k}])^2}{\text{Var}_t^*[F_{t+k,T}]},$$

where

$$\text{Cov}_t^*[F_{t+k,T}, S_{t+k}] = \exp(\phi\tau_{t+k})\text{Var}_t^*[S_{t+k}]$$

and

$$\text{Var}_t^*[F_{t+k,T}] = \exp(2\phi\tau_{t+k})\text{Var}_t^*[S_{t+k}].$$

Thus,

$$\begin{aligned}\text{Var}_t^*[P_{t+k}] &= \text{Var}_t^*[S_{t+k}] - \frac{(\exp(\phi\tau_{t+k})\text{Var}_t^*[S_{t+k}])^2}{\exp(2\phi\tau_{t+k})\text{Var}_t^*[S_{t+k}]}, \\ &= \text{Var}_t^*[S_{t+k}] - \frac{\exp(2\phi\tau_{t+k})(\text{Var}_t^*[S_{t+k}])^2}{\exp(2\phi\tau_{t+k})\text{Var}_t^*[S_{t+k}]}, \\ &= \text{Var}_t^*[S_{t+k}] - \text{Var}_t^*[S_{t+k}], \\ &= 0.\end{aligned}\tag{7}$$

Subsequently, the hedge portfolio would earn, R_{t+k}^p , the riskless net cost of carry return over the k day hedging period:

$$\begin{aligned}R_{t+k}^p &= R_{t+k}^s - h_t R_{t+k}^f, \\ &= \exp\{\phi\tau - \phi\tau_{t+k}\} - 1 \\ &= \exp\{\phi k\} - 1.\end{aligned}\tag{8}$$

Equation (8) implies that in a pure cost-of-carry market the effectiveness of the optimal hedging strategy is invariant to the futures contract maturity. That is, regardless of the contract's expiration date, i.e. serial or quarterly month, the hedging effectiveness of the trading strategy is the same.

Arbitrage Activity and Contract Expiration

So far, we only have considered trading implications for investors looking to protect a position in the equity market. For arbitrageurs, who buy and sell risk,

returns are also independent of the futures contract expiration month. To see this, consider a short selling strategy, whereby, the investor expects the stock price to drop over the next k days. The investor enters into a short position in the futures market, which after k days is reversed. Conditioned on the futures markets expiration month, m (where m is a serial month or quarterly month), the gross rate of return for this strategy in a pure cost-of-carry market is

$$\frac{F_{t,T_m}}{F_{t+k,T_m}} = \frac{S_t \exp[\phi(T_m - t)]}{S_{t+k} \exp[\phi(T_m - (t+k))]}$$

which simplifies to:

$$\frac{F_{t,T_m}}{F_{t+k,T_m}} = \frac{S_t}{S_{t+k}} \exp[\phi k]. \quad (9)$$

Equation (9) shows the gross rate of return for the arbitrageur's trading strategy is a function of the gross return in the equity market scaled by the time value of money factor. Moreover, the return is independent of T_m and is therefore invariant to the arbitrageur's choice of expiration month in the futures market. If returns are invariant to the expiration month, it follows that the arbitrageur will prefer to trade in the contract with the greatest amount of liquidity, since these markets provide the lowest transaction costs.

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