Margin Requirements in Futures Markets: Their Relationship to Price Volatility

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Brokers and exchanges require customers to provide security deposits called margins when they trade in futures markets. Minimum margin levels are set by exchanges and brokers must set margin requirements for their customers at least equal to these minimums. This system has come under attack as financial markets have experienced increased instability, and industry regulators have become more concerned about trade practice abuses. A two-year study by the Federal Reserve System (released in 1985) specifically recommends that a new federal agency be created to set margin requirements in both stock and futures markets. Renewed interest in such an agency developed after the October 1987 collapse of the stock market. In November 1987, a bill was introduced in the House of Representatives that "would empower the Federal Reserve Board to require purchasers of 'equity-like derivatives,' including stock index futures and options, to put up as much as 50% in cash.... Before the October 1987 collapse, buyers of stock index futures faced margins of 10 cents on the dollar, or even less."[1]

Specific proposals to alter the regulation of futures markets have emanated from the New York Stock Exchange, the Securities and Exchange Commission, the Commodities Futures Trading Commission, and the General Accounting Office. The Brady Commission, appointed by President Reagan, has recommended an overhaul of the regulatory system. The Commission viewed all financial markets as being interconnected and advocated one regulator, the Federal Reserve Board, to oversee all financial regulation. The Commission considered margins in different

[1]Jackson, Brook, and Ingersoll, Bruce, "Chicago Futures Industry, To Fend Off Limits, Rallies PAC-Sided Lawmakers," *The Wall Street Journal,* November 12, 1987, p. 76.

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markets to be similar and indicated that restrictions such as margin requirements should be treated similarly across markets. Equating margin requirements of futures contracts to those on stocks would significantly increase futures margin requirements.

Two issues must be addressed to analyze the relevant evidence for this debate. First, it must be determined how margins are currently set and whether this is an appropriate procedure. Second, the effect of changes in margins on price volatility must be examined. The reform proposals assume that margin changes can alter the price volatility of futures contracts and that therefore the government should be empowered to reduce volatility by having control of margins. Previous studies of margin requirements have employed limited data sets and have not examined these issues fully.

This article examines both issues with a more extensive data set covering margin changes from 1972 to 1988. It is found that margins are, in fact, set in the manner stated by the exchanges and that these methods are in accordance with economic theory. The evidence is mixed, however, with respect to the effects of margin changes on price volatility. It is difficult to determine whether margins changes increase or decrease volatility. Consequently, a government policy that uses margins to affect price volatility is ill-advised because of the unclear empirical relationship.

The first section of the article discusses the economic role of margins in futures markets and reviews the theoretical and empirical literature. The second section presents the position of exchange spokesmen about the factors affecting the setting of margins and establishes a model of margin setting that can be tested. This model is tested in the third section using two sets of data. The most important tests use time series data from 1972–1988 for ten contracts traded on the Chicago Board of Trade. The second data set consists of all contracts for one point of time (November 1, 1984). The fourth section presents the alternative hypotheses about the effect of margin changes on volatility. The fifth section tests these hypotheses using the time series data from the Chicago Board of Trade from 1972–1988. In the concluding section, the results are summarized and the implications for reform of the margin setting procedure are evaluated.

I. THE ROLE OF MARGINS IN FUTURES MARKETS

An individual buying or selling a futures contract agrees to a transaction involving the exchange of funds for goods at a given time in the future. If the spot price of the good changes, the individual is either better or worse off depending upon the position taken (i.e., either a net buyer or net seller) and the direction of the price movement. If the movement of prices is adverse to the individual, he may decide that it is advantageous for him to renege on the agreement or delay payment for as long as possible rather than complete the transaction in a timely manner. With margins, traders must include an additional cost in their calculation to default or delay payment. If the price moves against a trader, he is required to deposit additional funds before trading begins the next day. If the loss is less than the margin then the broker is fully protected from the possibility of default assuming he can close the contract on the next day. However, if the margin does not cover the loss or the contract cannot be traded on the next day, the broker is subject to delay or default risk. The individual may decide to default when the margin is less than the expected loss, so that if he does not come up with the additional margin and refuses to cover the losses at a later date, he may gain financially. The expected gain for the individual in this instance depends on the probability that the broker can regain the

loss by legal action. Against this gain from noncompliance, the individual will weigh the cost of depositing additional margin.

As trading commences, an initial margin is required. Customers may keep a lower level in their account, subsequently called a maintenance margin. Maintenance margins are adjusted daily (i.e., marked-to-market) as prices change. When a customer's margin holdings fall below the maintenance margin level, he must increase the account to the level of the initial margin.

The argument that margins serve as security deposits has been suggested by Telser (1981). Drawing on Telser's observations, Fishe and Goldberg (1986) developed a formal profit-maximizing model of a customer's trading decision when margins are required, and established results relating trading profits to margin levels, court costs (e.g., when the broker sues a defaulting customer), the probability of plaintiff success in a court challenge, and price variability of the contract. This approach implies that margin levels are set to maintain margins as viable security deposits. Factors increasing market instability increase the probability of default and lead the margin setting authorities to increase the level of margins. Because it is assumed that exchanges attempt to maximize the profits of member firms, however, there is a conflict between stimulating trading and minimizing defaults. Balancing these two goals is the task of the margin setting authority.

Previous empirical work on margins can be placed into three main categories: the effects of margins on performance; relating margins to the probability of default; and factors affecting margin determination. Because this article examines how margins are set and the effects of margins on price volatility, all three bodies of literature are relevant.

The early empirical studies used limited data samples and examined the effects of margins on price volatility, trading volume, and open interest (e.g., Nathon (1967), McCain (1969), and Hieronymous (1971)) and generally did not find any significant impact. Irwin and Peck (1984) examined the effects of margin levels on pricing performance and found higher margin levels associated with a wider price dispersion and thus less efficient price formation. Fishe and Goldberg (1986) examined all margin changes for contracts traded on the Chicago Board of Trade between 1972 and 1978 and found that the quantity of futures contracts traded varies inversely with margin requirements for contracts with nearby delivery months but that there was no significant effect on trading for contracts with more distant delivery months. Tomek's (1985) research also supported the finding of an inverse relationship between margins and trading activity. Hartzmark (1986) examined thirteen margin changes in four markets between 1977 and 1981. His results, admittedly based on a small sample, showed that margins affect the composition of traders (i.e., commercial versus noncommercial traders) and are inversely related to open interest but do not affect the volume of trading. Using nonparametric tests, he found no systematic relationship between margins and price volatility; that is, changes in margins do not increase or decrease price volatility. The existing evidence then appears to show that margins affect open interest but do not systematically affect price volatility. None of the previous studies used a large data sample (such as used here) to examine the relationship between margins and price volatility.

The second group of studies relates margins to price distributions, thereby evaluating the role of margins in preventing default. Kuhn (1976) analyzed how margin requirements should be determined to reduce the incidence of default. She looked at past price behavior and estimated frequencies of various levels of price changes to determine the chance of default. She found that the level of risk allowed by ex-

changes differed substantially over time. Figlewski (1984) analyzed the degree of protection provided by different margin levels too, but developed a theoretical model to account for mean return and volatility of security prices. He applied his model to data on stock index futures contracts and found that extant margins provide adequate protection against default. Irwin and Peck (1984) also investigated the performance assurance provided by margins. They examined data from 1970–1982 for agricultural, financial, and metal futures contracts and concluded that exchanges set margins at very "conservative" levels.

Three studies have investigated the determinants of margins. Telser and Higinbotham (1977) regressed margin levels at brokerage firms during the first half of 1976 for 23 commodities on log volume, log open interest, average price of the contract, and several measures of price variability. They found a negative coefficient for log volume, positive coefficients for log open interest and contract price, and mixed results for the price variability measures. Kuhn (1974) tried to explain margin levels and changes with several market variables, price range, price level, volume, and open interest for five commodities. She found that price and lagged margin level were the most important determinants of margins. Tomek (1985) examined how the average margin level in a given year was affected by the corresponding standard deviation of prices in that year. He investigated this relationship for eight different commodity contracts. Even though he did not relate actual margin levels or margin changes at a point in time to price volatility, he concluded that exchanges are generally successful in relating margin levels to price volatility.

II. SETTING MARGINS

The discussion above identifies several factors that are important for setting margins, such as contract value and price variability. Below is a discussion of factors that the exchanges examine when their margin-setting committees make margin changes.

An interview in June 1984 with a member of the margin committee of the Chicago Board of Trade revealed five factors used by the committee to determine margin levels: price volatility; special circumstances (e.g., the Hunt brothers silver episode); daily price limits; price of the contract (i.e., margin as a rough percentage of the total contract value); and open interest and volume. With respect to the last factor, the committee is particularly interested in changes in quantity. Initially, the margin is set as 3–6% of the contract value. The committee attempts to have margins cover 90% of all daily price changes. Rutz (1984) has specified a group of factors considered by the margin committee in setting performance margins. "These factors include changes in (a) price levels, (b) price variability, (c) volume, (d) open interest, and (e) concentration of futures positions. In addition, the experience and knowledge of the members of the margin committee are vital in determining the appropriate levels of performance-margins, which are incorporated into their decisions."[2]

In a statement to the Federal Reserve Board in response to a study by the Board's staff on margin requirements, Thomas Donovan, President of the Chicago Board of Trade, stated that "futures exchanges establish performance-margins and make subsequent changes based on price variability and additional market factors having an impact on risk. By altering performance margins to be consistent with the risk of loss (default) resulting from price volatility and other market factors, futures

[2]Rutz (1984), p. 17.

exchanges are best able to protect the integrity of the markets."[3] A prior President of the Chicago Board of Trade Clearing Corporation enumerated similar factors which are taken into account in establishing margins. He emphasized daily price limits, market volatility, and special circumstances when a "super margin" is required (Brinkman (1981)).

Given these statements and the theoretical framework outlined above, an appropriate model of margins may be represented by the relationship:

$$M = f(C, X, OI) \tag{1}$$

where

M = margin level (dollars per contract),
C = total price of the contract,
X = price variablity prior to date in question,
OI = open interest,

Three factors enumerated by exchange officials as secondary factors considered in margin setting are omitted from this model: special circumstances, daily price limits, and volume. Special circumstances can not be easily quantified. Daily price limits, which are usually set simultaneously with margin levels, are expected to be highly correlated with margin levels. Because the determination of margin levels and price limits are affected by the same factors, however, price limits cannot be used as an explanatory variable for margin levels. Volume is omitted because it is highly correlated with open interest.

Total contract price is expected to be positively correlated with margin levels because greater margins are needed to protect against default on larger value contracts. Greater price variablity requires higher margins to maintain protection. Higher levels of open interest indicate increased contract liquidity and lower risk, thereby decreasing required margins.

III. EMPIRICAL TESTS OF MARGIN DETERMINATION

Both time series data, based on contracts traded on the Chicago Board of Trade from 1972–1988, and cross section data on futures contracts in 1984 are used to test the margin determination model. Summary statistics are presented for the first set of data in Table I. The ten commodities utilized are corn, gold, iced broilers, oats, plywood, silver, soybeans, soymeal, soyoil, and wheat.[4] The nearest four contracts traded for each commodity at the time of a margin change, excluding contracts expiring within one month or those with insufficient trading volume, are selected. Summary statistics are reported for a twenty day period before a change in initial margin requirements.

In Table I, the average total price of a contract is calculated using contract size and settlement prices over this twenty day period. The average open interest and the standard deviation of the difference between daily high and low prices are presented also in Table I. Grammatikos and Saunders (1986) suggest that the latter measure may be superior to other measures of variability such as "the square of daily price change, the rate of price change, the absolute value of the percentage change in daily closing prices and the variance of closing prices over a fixed period."[5] The standard deviation of the difference in high and low price is more theo-

[3]Donovan (1983), p. 2.

[4]Note that 1979 and 1980 are excluded in the case of silver because of the special nature of the Hunt Brothers episode. Inclusion of these years did not significantly alter the results.

[5]Grammatikos and Saunders (1986), p. 320.

Table I
MEAN VALUES AND STANDARD DEVIATIONS OF SAMPLE DATA*

Commodity (Symbol)	New Margin	Standard Deviation of High-Low Spread	Average Open Interest	Average Settlement Price
Corn (C)	957.21	122.29	132254.32	12619.94
	(505.67)	(89.11)	(128622.84)	(3066.48)
Gold				
Troy (AU)	3580.00	595.54	618.45	51729.60
	(1078.49)	(202.86)	(450.95)	(10360.42)
3 Kilo (G)	783.33	120.67	565.93	17052.57
	(319.18)	(63.04)	(234.25)	(1249.59)
1 Kilo (KI)	553.85	107.68	287.80	11966.68
	(110.80)	(70.04)	(305.27)	(1930.67)
Iced Broilers (IB)	808.82	143.69	172.75	11483.86
	(303.75)	(80.75)	(912.14)	(1584.92)
Oats (O)	601.59	126.29	6823.93	8930.39
	(231.23)	(115.62)	(5963.54)	(2977.23)
Plywood (PW)	1085.00	138.73	1026.10	10233.71
	(473.81)	(49.13)	(338.17)	(1974.78)
Silver				
1000 oz. (AG)	655.91	121.83	4317.41	8692.89
	(244.90)	(66.63)	(5293.65)	(2809.71)
5000 oz. (SI)	1907.78	362.84	15450.03	27322.34
	(1110.28)	(215.31)	(12582.60)	(17720.58)
Soybeans (S)	2529.63	368.26	90174.66	33518.98
	(1258.26)	(186.67)	(79488.59)	(6712.72)
Soymeal (SM)	1526.13	256.67	8745.96	19160.54
	(814.86)	(131.45)	(7528.69)	(4620.89)
Soyoil (BO)	1030.17	183.78	11160.70	14636.83
	(352.56)	(79.50)	(8063.60)	(2964.97)
Wheat (W)	1253.61	189.41	45076.80	18167.04
	(575.93)	(95.09)	(32975.38)	(4132.46)

*Standard Deviations in parenthesis under means.

retically appropriate because it captures how the maximum price range is changing, and thus represents the limiting case of default risk. Note that in the cross section tests several measures of price variability are employed to determine if they offer similar results.

The regression results for a simplified version of the model are presented in Table II by commodity. The inclusion of the other independent variables offers little additional explanatory power. The dependent variable is the *new* initial margin level required on a contract. Because other margin levels move very closely with the initial margin, the initial margin is used as a proxy for all margin levels. The results are separated by commodity because the idea of pooling of these data is rejected under two different scenarios: the case where all coefficients are restricted to be equal ($F_{36,708} = 4.66$) and the case where the constant terms are allowed to vary but the slopes are constrained ($F_{27,717} = 5.40$).

Table II

TEST FOR DETERMINANTS OF NEW MARGIN LEVELS. SHOWN ARE RESULTS OF ESTIMATION OF REGRESSION MODEL LISTED BELOW. *T* STATISTICS FOR TEST OF COEFFICIENTS BEING DIFFERENT FROM ZERO ARE IN PARENTHESIS

	Corn	Gold	Iced Broiler	Oats	Plywood	Silver	Soybeans	Soymeal	Soyoil	Wheat
Intercept	492.75*	−408.79**	−673.61	617.83**	25.40	63.17	699.90	144.33	229.02	−94.73
	(2.314)	(−3.210)	(−2.014)	(7.744)	(0.040)	(1.020)	(1.388)	(0.620)	(1.745)	(−0.521)
Average Settlement Price (SETTLEBAR)	0.036*	0.058**	0.116*	−0.033**	0.053	0.019**	0.016	0.028	0.052**	0.044**
	(2.038)	(10.171)	(3.339)	(−2.707)	(0.988)	(3.597)	(0.836)	(1.639)	(5.080)	(4.147)
Standard Deviation of High-Low Spread (HILOSTD)	1.175	1.741**	0.117	2.145**	4.256	3.372**	4.171**	3.914**	0.960**	3.672**
	(1.733)	(3.772)	(0.191)	(6.885)	(1.983)	(7.958)	(6.105)	(6.932)	(2.499)	(7.799)
Average Open Interest (OPINTBAR)	−0.001**	0.012	0.115	0.001	−0.073	0.006	−0.003**	−0.018**	−0.013**	−0.003**
	(−2.436)	(0.065)	(1.952)	(0.330)	(−0.251)	(1.896)	(−2.332)	(−2.383)	(−4.050)	(−2.796)
N	103	36	16	62	19	88	107	110	115	82
R^2	0.13	0.96	0.81	0.56	0.20	0.90	0.44	0.55	0.40	0.62
F	6.26*	267.20**	24.10**	27.59**	2.57	257.02**	28.55**	46.04**	26.71**	46.08**

$$NEWMARG_i = \beta_0 + \beta_1^* SETTLEBAR_i + \beta_2^* HILOSTD_i + \beta_3^* OPINTBAR_i + \epsilon_i$$

*Significant at 5% level, two-tailed test.

**Significant at 1% level, two-tailed test.

In the regression equations, the coefficient of total contract price is positive and statistically significant at the 5% level using a two-tailed test for six commodities, with five estimates significant at the 1% level; thus confirming the hypothesis that margin determination is dependent on the value of the contract. Three coefficients are positive but statistically insignificant and only in the case of oats is the coefficient negative. The strongest results are those on the price volatility measure. All of these coefficients are positive as predicted and seven are significant at the 5% level and six at the 1% level. The magnitudes of the coefficients vary somewhat with the smallest values for iced broilers and soybean oil. Other measures of price volatility are employed in alternative formulations. Positive coefficients are generally obtained; but the results are not as strong or consistent as those obtained using the standard deviation of the difference in high and low prices.[6]

The coefficient on open interest is negative in six cases (five are significant at the 5% level) and positive in four cases, yielding mixed results. Other regressions were run including the change in open interest, volume, and the change in volume. A complete exposition of these results is omitted for sake of brevity, however, inclusion of these three extra variables did not greatly alter the significance or magnitude of the coefficients of the price and price volatility variables. For the complete model, open interest or volume coefficients were statistically significant in only two equations.

The relative importance of the three independent variables upon margin levels is tested next. Table III presents elasticity measures for each of the variables by commodity. Note that changes in the average settlement price and price variability are likely to have much larger effects upon margin levels than changes in open interest. Responsiveness varies substantially by contract. In five cases an increase in the value of the contract increases the margin level proportionately more than for an increase in price variability. The situation is reversed in the other five cases.

Table III
ELASTICITIES OF NEW MARGINS AT THE MEAN WITH RESPECT TO THE INDEPENDENT VARIABLES AT THEIR MEANS

Commodity	Average Settlement Price	Standard Deviation of High-Low Spread	Average Open Interest
Soyoil	0.7454	0.1714	−0.1391
Corn	0.4775	0.1501	−0.1423
Gold	0.9268	0.2925	0.0032
Iced Broilers	1.6445	0.0209	0.1675
Oats	−0.4913	0.4504	0.0139
Plywood	0.5016	0.5441	−0.0691
Soybeans	0.2154	0.6072	−0.0993
Soymeal	0.3527	0.6583	−0.1056
Silver	0.2702	0.6351	0.0459
Wheat	0.6419	0.5548	−0.1211

[6]Other price volatility measures used were the standard deviation of closing prices, the average price change of high-low prices, and the average price change of closing prices.

The model specified in eq. (1) is tested again using data consisting of all contracts for which sufficient information is available at one point in time. A complete set of margin requirements for all futures contracts as of November 1, 1984 was obtained from one of the largest brokerage firms in the country. In testing the margin determination model, the house margin set by the firm and the absolute minimum margin set by the exchange (initial margins) are utilized. Information on specific contracts is from *The Wall Street Journal*.[7] Only the two nearest term contracts (excluding those expiring in November) are used. Because the newspaper lists prices and open interest for each contract but lists volume only across all contracts for that commodity, volume measures are not included in the analysis. The value of each contract on November 1 is calculated by multiplying price by contract size. Open interest and prices are collected for the twenty trading days prior to November 1, excluding October 31, to account for the lag between announcement of new margins and the actual implementation of new margins. Open interest (OI) is calculated as the average open interest for the twenty days and ΔOI is the percentage change in open interest from the first day to the twentieth day. Four measures of price variability, placing each one in a separate regression equation, are used. The measures used are:

X_1 = average absolute value of change in closing prices/average closing price
X_2 = average difference of high and low prices/average low price
X_3 = the variance of the change in closing prices
X_4 = the variance of the high and low price differences

The results of this analysis are presented in Table IV. The first four regressions use the margin required by a major brokerage house on November 1, 1984 as the dependent variable. The second four regressions use the minimum margin required by the exchanges on that date. One might expect the exogenous variables to do a better job explaining the margins set by the brokerage house vs. the exchange because a brokerage house may adjust more rapidly to changes in the marketplace. In all equations, the coefficient of the price of the contract is statistically significant at the 1% level confirming the hypothesis that margin determination is dependent on the value of the contract. Open interest is never significant and must be dismissed as an important factor. The change in open interest is always the expected sign (positive) and is significant at the 10% level in all but one case. Greater volatility in quantity appears to lead to higher margins as hypothesized. Finally, all price variability measures have positive coefficients and are significant at the 5% or 1% level. The coefficients have the correct sign in all exchange margin equations and are statistically significant at the 5% level in two cases. Consequently, though the evidence that price variability is an important determinant of margins for the margins set by the brokerage house is stronger, there is a reasonable amount of evidence that it is also an important determinant of exchange margins.

Results from both sets of data are reasonably consistent. Margins appear to be set in the manner specified by the exchanges. To evaluate further the desirability of government intervention in the margin setting process the effects of margins on price volatility are now considered.

[7]Contracts reported both in the *The Wall Street Journal* and in the margin list were included. Certain financial contracts, where calculations of the appropriate variables from reported data were too complicated, were omitted.

Table IV

CROSS SECTIONAL REGRESSIONS OF HOUSE AND EXCHANGE MARGIN REQUIREMENTS ON AVERAGE SETTLEMENT PRICES, OPEN INTEREST MEASURES, AND VARIOUS VOLATILITY MEASURES ON NOVEMBER 1, 1984

	Average Settlement Price	Average Open Interest	Change in Open Interest	Measure of Volatility	R^2	n
			House Margin			
X_1	.0414**	.0025	32.9301*	79384.16**	.49	59
	(6.8959)	(.4037)	(2.0147)	(3.2801)		
X_2	.0407**	.0032	30.2900	39758.79**	.48	57
	(6.6826)	(.5079)	(1.8259)	(2.9698)		
X_3	.0377**	.0027	32.5022	.00005*	.45	59
	(6.0485)	(.4050)	(1.9165)	(2.5094)		
X_4	.0374**	.0021	31.9470	.00001**	.47	57
	(6.0854)	(.3225)	(1.9168)	(2.8778)		
			Exchange Margin			
	Average Settlement Price	**Average Open Interest**	**Change in Open Interest**	**Measure of Volatility**	R^2	n
X_1	.0250**	.0021	30.2464*	44858.61*	.31	59
	(4.7456)	(.3742)	(2.1131)	(2.1173)		
X_2	.0246**	.0024	28.7337*	24416.91*	.31	57
	(4.6876)	(.4347)	(2.0090)	(2.1154)		
X_3	.0234*	.0027	29.4957	.00001	.26	59
	(4.2847)	(.4658)	(1.9895)	(.8106)		
X_4	.0232**	.0024	29.3952	.000004	.27	57
	(4.2637)	(.4195)	(1.9930)	(1.0654)		

t-statistic are given in parentheses

*Significant at 5% level, two-tailed test.
**Significant at 1% level, two-tailed test.

IV. THE IMPACT OF MARGIN CHANGES ON PRICE VOLATILITY

There are three alternative hypotheses that may explain the effect of margin changes on price volatility. The first hypothesis is the basis for the proposals to use changes in margins as a policy tool. Increases in margins increase the cost of trading contracts by increasing the security deposit and thus the cost of default, which would reduce open interest. The increased cost of trading is expected to affect speculators more than hedgers or traders expecting to take delivery. Some speculators will then leave the market or become day traders. A day trader does not carry positions overnight and is not required to post margins. If speculators, who allegedly have a destabilizing effect on prices, leave the market, then price variability would be reduced. Consequently there would be a negative relationship between changes in margins and price volatility.

The second hypothesis also is based on margins raising costs and driving market participants away. However, in this case the higher margins would result in reduced volume and thus a less liquid market. A thinner and less competitive market might then exhibit greater price volatility than before the margin increase. Consequently,

if higher margins drive some liquidity-producing traders out of the market, one might find a positive relationship between margin changes and price volatility.

A final hypothesis is that the changes in margins examined here are too small to have a noticeable effect on volatility.[8] Therefore, one might expect no relationship between margins and volatility. Alternatively, the first two effects may tend to cancel each other out and produce no significant relationship. Clearly, the net effect depends on the type of traders removed from the market. In addition, the market reaction may differ by contract and by the size of margin changes for each contract.

V. TESTING THE RELATIONSHIP BETWEEN MARGIN CHANGES AND PRICE VOLATILITY

All initial margin changes for the ten commodities listed above are examined from 1972 to 1988. For each margin change, the price volatility of the contract is calculated for twenty days before and after the margin change. Several measures of price volatility are used, again with similar findings; but results are presented here for only the theoretically best measure, the standard deviation of the difference between high and low prices for the day.

Table V shows the results of testing for price volatility changes after margin changes. The entries are significance levels from Pearson's χ^2 test and indicate the probability that a given null hypothesis is true. The first column examines all margin changes by commodity. The hypothesis that the before and after standard deviations are equal is rejected at the 5% level for each commodity and all commodities combined. In columns 2 and 3, the margin changes are divided into increases and decreases to test the direction of the change in volatility. If the proponents of government regulation are correct, margin increases are expected to decrease volatility while margin decreases are expected to increase volatility. The significance levels shown in columns 2 and 3 offer only weak support for the pro-regulation position. For the cases where margins increased, three contracts support the pro-regulation position and for margin decreases, the position is confirmed in six out of ten cases. Symmetry is necessary for the pro-regulation position to be implemented, and it is found that only two contracts are significant for both margin increases and decreases.

The above analysis does not differentiate among margin changes by size of the margin change. For example, larger margin changes might be expected to produce greater effects on price volatility. Consequently, the percentage change in price volatility (as measured by the change in the standard deviation of the difference between the high and low price for the day) is regressed before and after the margin change on the percentage change in margins and the percentage change in open interest. Again, the regression is run with all observations combined and then the sample divided into margin increases and decreases.

Table VI presents the *t*-values of the coefficients of the percentage change in margins and percentage change in open interest variables for the twenty day data estimated using the following model:

$$\Delta SDHC = f(\Delta M, \Delta OI) \tag{2}$$

The results are mixed. When all commodities are considered, no statistically significant coefficients are found for either variable. For the regressions with all mar-

[8]These hypotheses are very similar to those presented by Hartzmark (1986).

Table V

TESTS FOR DIFFERENCES IN THE VARIANCE OF THE HIGH-LOW SPREAD BEFORE (σ_B^2) THE MARGIN CHANGE AND THE VARIANCE OF THE HIGH-LOW SPREAD AFTER (σ_A^2) THE MARGIN CHANGE. PRESENTED ARE THE PROBABILITIES FROM PEARSON'S P_A TEST, THAT THE NULL HYPOTHESES ARE TRUE. NULL AND ALTERNATIVE HYPOTHESES ARE PRESENTED BELOW

Commodity	All Margin Changes	Margin Increases	Margin Decreases
All	0.0001	0.0045	0.0001
Corn	0.0001	0.0820	0.0010
Gold	0.0001	0.8827	0.0386
Iced Broilers	0.0001	0.0001	0.0003
Oats	0.0013	0.0002	0.5057
Plywood	0.0049	0.1842	0.6165
Silver	0.0001	0.9949	0.0664
Soybeans	0.0001	0.9957	0.0001
Soymeal	0.0001	0.1489	0.0001
Soyoil	0.0057	0.9926	0.0954
Wheat	0.0001	0.0005	0.0033
For All Changes			
H_O: $\sigma_B^2 = \sigma_A^2$			
H_A: $\sigma_B^2 \neq \sigma_A^2$			
For Increases			
H_O: $\sigma_B^2 \leq \sigma_A^2$			
H_A: $\sigma_B^2 > \sigma_A^2$			
For Decreases			
H_O: $\sigma_B^2 \geq \sigma_A^2$			
H_A: $\sigma_B^2 < \sigma_A^2$			

gin changes, only silver has a significant coefficient (negative) for the margin change variable. For margin increases, two commodities have significant negative coefficients. In the case of margin decreases, two commodities have significant positive coefficients and one significant negative coefficient. The open interest variable is statistically significant at the 5 percent level only in three cases when margins increase (1 positive and 2 negative).

The empirical evidence shows that there is an inconsistent relationship between margin changes and price volatility. Therefore, arguments for government manipulation of futures markets through margin policy are weakened. Given the variability of results, it would be unwise to rely on margins to reduce volatility, even in the few instances where it appears that the relationship holds. To confidently apply this procedure to a particular commodity, further evidence of the stability of the negative relationship over time must be documented.

VI. CONCLUSION

The evidence presented here provides almost no support for the proposals to have the government establish margin requirements on futures contracts. It is

Table VI

T-STATISTICS FOR THE COEFFICIENTS IN THE REGRESSION OF PERCENTAGE CHANGE IN STANDARD DEVIATION OF HIGH-LOW SPREAD WITH PERCENTAGE CHANGE IN MARGIN AND PERCENTAGE CHANGE IN OPEN INTEREST BEFORE AND AFTER THE MARGINS CHANGE (MODEL SHOWN BELOW)

	All Margin Changes		Margin Increases		Margin Decreases	
Commodity	% Margin Change	% Open Int Change	% Margin Change	% Open Int Change	% Margin Change	% Open Int Change
All	−0.647	0.668	−1.309	−0.272	1.410	0.554
Corn	0.942	1.503	−0.580	1.813	1.436	0.378
Gold	−1.572	0.601	−1.584	−2.740*	0.278	0.357
Iced Broilers	1.473	−1.943	1.119	−2.197*	−0.372	4.125*
Oats	0.969	0.384	0.081	−0.093	1.098	1.031
Plywood	0.340	−1.160	0.908	−0.612	0.965	−0.946
Silver	−2.317*	1.713	−5.377*	0.729	−2.046*	1.793
Soybeans	−0.460	0.430	0.329	2.648*	1.159	−0.059
Soymeal	0.563	−0.598	−0.527	−0.194	2.976*	−0.860
Soyoil	−1.655	1.249	−1.287	1.676	1.367	0.646
Wheat	−0.171	0.718	−4.439*	1.767	2.089*	−0.329

*Significant at 5% level, two-tailed test.

$\%\Delta\text{Volatility}_i = \beta_0 + \beta_1 * \%\Delta\text{Margin}_i + \beta_2 * \%\Delta\text{Open Int}_i + \epsilon_i$.

shown that the margins are currently set in accordance with the stated intentions of industry officials and that these also coincide with a theoretically proper role for margins. Contract value and price volatility prior to the margin change data are important factors in determining new margin levels. In addition, it is shown that the negative relationship between margin changes and price volatility, hypothesized by advocates of government intervention, does not appear to exist. The lack of a consistent relationship would appear to undermine any efforts by the government to alter trading behavior by adjusting margin levels.

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