Execution Costs for a Public Futures Fund

by

Thomas V. Greer and B. Wade Brorsen

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Execution costs are the transactions costs for futures contracts other than brokerage commissions. Execution costs arise when market orders arrive but receive execution at a price different from that which prevailed when the order arrived. The purpose of this research is to determine the size and the causes for execution costs for different markets and commodities. Various users of futures markets need realistic approximations of execution costs. Commodity futures fund trading managers need to know the size of execution costs and how they vary across commodities in order to account for these costs when technical trading computer models are designed and evaluated. Futures market regulators and administrators need to know the size of execution costs when evaluating the potential benefits from adopting electronic trading or increased trading hours. Academic and industry researchers need to account for execution costs when simulating hedging and speculative activities involving futures markets. In this research the trading record of a public futures fund is used to determine execution costs for the fund's transactions, and thus provides previously unavailable information about the size of execution costs across several futures markets.

Transactions costs can be divided into two basic components--brokerage commissions and execution costs (See Figure 1). Execution costs can be divided into two components--liquidity costs and slippage. Liquidity costs arise when market orders want immediate execution in the market. Such execution would be easy if both buy and sell orders of equal size arrived in the market simultaneously, but this is not typical. Scalpers will execute an order on arrival, but will move the price up from the last transaction for a buy order and down for a sell order to cover the cost of making a market. The bid-ask spread is a measure of scalpers' charges for liquidity costs. Slippage arises in volatile markets because prices can move rapidly before execution is achieved. Complaints about poor execution are common, but slippage can be both favorable and unfavorable.

Glosten and Harris (1988) have broken liquidity costs into two components--a transitory component and an adverse selection component. The transitory component is that part of the bid-ask spread which generates returns for scalpers. The adverse selection component arises because scalpers trade with unidentified investors who may have superior information. For example, hedgers at a minimum have knowledge of the actual physical quantity they are hedging. A large flow of buy orders arouses concern by scalpers who will increase their premiums to cover the risk that buyers know something they do not know. The wider bid ask spread will increase the returns from sell orders to match any losses to superior information in the hands of buyers and protect the scalpers' profits.

Brokerage costs are generally employed in simulation models, although with the rise of discount brokers, the range of possible costs is large. Much research has only adjusted for commission costs, often in a simple manner. For example, Curtis et al. (1987) assumed commission charges per round turn to be two cents per bushel for soybeans. Bailey and Brorsen (1985) calculated commission and interest costs based on cut-rate commission

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fees at $25 per contract for feeder cattle. Substantial variation can be found for those who modeled transactions costs as well. For example, Schroeder and Hayenga (1987) modeled futures transactions in feeder cattle, corn and fed cattle at $60 per contract (round turn). Bird (1985) assumed transactions costs to be one percent of contract value on each transaction for sugar, cocoa, and coffee on the London market. Schwager (1984) suggests using a transaction cost per trade assumption much greater than the actual historical commission costs (e.g., $150 or $200 per trade). These models appear to adjust for execution costs only by overestimating commission costs.

Past research on liquidity costs falls into two categories: 1) those that use transaction data (actually intraday price changes since each transaction is not recorded) and 2) those that use trading records of floor traders. Neither source of data can provide an estimate of slippage. The transaction data studies (Thompson and Waller (1987); Martell and Helms (1979); and Brorsen (1989)) estimate liquidity costs as the size of absolute price changes and the transitory component of liquidity costs by simulating a scalping rule. The trading records of floor traders were examined by Silber (1984) and Working (1977) give scalping returns which are only estimates of the transitory component of liquidity costs.

Sources of Execution Costs

The costs of slippage are difficult to measure. When an order is placed it is unusual to find any record of what the target execution price was relative to the execution received. But not all orders are market orders. Market slippage can also occur on stop orders (sometimes called market-if-touched orders) to buy at the market when a specified price is reached. Even though this order is already on the floor in a trader's pocket, it can often have an execution cost greater than the bid-ask spread of scalping costs in volatile markets. Poor execution is a common complaint of futures markets participants. Since the market can move either way, slippage can be negative. Many commodity futures trading funds use stop orders because their trading systems provide target prices for transactions.

Many public futures funds rely on technical trading models to obtain targets for trading activity. Generally, these models are trend following models and have particular targets to buy and sell futures contracts. The funds may place stop orders with brokers for execution if market prices reach the targets. Execution of these stop orders may have execution costs. If several contracts are traded, it becomes less likely that all contracts will be executed at the same price.

In general, stop orders would be expected to be executed at or near the stop price, since the broker holding the order should be aware that market movement is about to trigger a stop order and should try to get good execution. However, trading by futures funds (and most other technical traders) is trend-following. Hence, if the market triggers a buy stop, the market may move past the target before execution is accomplished. If expectations are fulfilled, the probability of execution with substantial liquidity costs increases. Lukac et al. (1988) show different trading systems do trade similarly and thus a number of stop orders may be clustered together. Another source of slippage could be the phenomenon of "gunning for the stops" or "gather in the stops" which is defined as selling a sufficient amount to drive prices down to a point where stop orders are known to exist. The stop orders then become market orders which add liquidity to a thin market and give floor traders a chance to profit (Downes and Goodman (1987)).

Data and Procedures

Commodity futures funds have grown in importance in commodity futures markets. Public futures funds grew from $7.2 million to $435.1 million over the period January 1975-March 1984 (Irwin and Brorsen (1985)). Public and private funds were estimated to control $1.5 billion in 1985 (Laing (1986)). We have examined the trading records of a commodity fund which used a technical trading system in several commodity markets. The system was not continuously in the market in that it allowed for going long, short, or neutral in the commodities traded. The fund probably traded slightly more often than the average trading fund. The fund used stop orders entered before trading opened each day for most of its targeted trading activity. The fund used a discount broker. The fund had assets of $.7-1.2 million. We examined records for 11 commodities traded from July 1984 to December 1986. The commodities were world sugar, coffee, pork bellies, soybean meal, heating oil, Japanese yen, German mark, treasury bills, copper, platinum, and gold.

All market orders and limit orders were discarded. Generally the fund used market orders to roll contracts forward as they approached maturity and sometimes to get out of a losing position rapidly. The remaining orders were stop orders which were examined for execution at opening prices to determine whether execution costs represented interday gaps. Execution costs associated with interday gaps or limit moves were deleted. The stop price (STOP) was noted and compared with the execution price or prices. For contracts where execution occurred at multiple prices, a weighted average execution price (AP) was calculated. The stop price was subtracted from the execution price for buy orders and the execution price was subtracted from the stop price for sell orders to determine execution costs. The execution costs were multiplied by contract size (CS) to determine execution costs in terms of dollars per contract (DCEC).

(1) $DCEC = (AP - STOP) * CS$

In addition, execution costs were divided by stop prices to determine execution costs as a percentage of contract values as measured by the target values (PCEC).

(2) $PCEC = (AP - STOP) / STOP$

Simple regression models were used to explain execution cost magnitudes, based on data relating to volatility, volume, size of order, markets, and whether orders were to buy or sell. Data was gathered on the range of prices on the day transactions took place (RANGE) and the volume for the contract on that day (VOLUME). A variable was created to measure the number of contracts traded for each stop order which was then divided by volume so that it would show whether the order was large or small relative to market activity (NCV). Dummy variables were created to show when the market was located in New York (NY) (rather than Chicago), or when transactions were buy orders (BUY) (rather than sell orders). Execution costs as a percent of stop prices (PCTEC) were estimated as follows:

$$(3)\ PCTEC = a_0 + a_1*RANGE + a_2*VOLUME + a_3*BUY + a_4*NY + a_5*NCV$$

Large variations in execution costs as a percentage of stop prices suggested a better measure might be execution costs as a percent of average contract margins. Dollar per contract execution costs were corrected to reflect the average margin per contract by commodity (PCTMARG). Adjusted margins for each commodity were obtained from a study by Brorsen and Lukac (1988). The volatility measure was also corrected as a measure of average margin requirements (RANMARG) to be on a common basis and the regression model was estimated as follows:

$$(4)\ PCTMARG = b_0 + b_1*RANMARG + b_2*VOLUME + b_3*BUY + b_4*NY + b_5*NCV$$

Results

Execution costs are presented in Table I. Execution costs as a percent of the stop price averaged .18 percent. The lowest average cost for an individual commodity was for treasury bills at .0054 percent, but this is affected by the fact that treasury bills are traded in interest rate points discounted from 100 percent. This tends to inflate the contract values relative to changes in interest rates and make execution costs smaller on a percentage basis. The German mark average execution cost at .0383 percent was next lowest, but other commodities showed substantially higher execution costs. For example, heating oil had an average execution cost of .5050 percent, platinum was .4335 percent, and gold was .2739 percent.

Silber (1984) and Working (1977) studied scalping costs by examining actual trading records of scalpers. Both found that scalping costs were small, since scalpers made very little profit per contract traded. Working noted that floor traders often did both scalping and day trading, but Silber examined records for a pure scalper. Silber found scalping returns of .026 percent of contract value for a scalper of the New York Stock Exchange Composite Index futures. Working found returns of .023 percent of contract value for a trader in New York cotton futures. All these costs are substantially below the execution costs found in this study.

Brorsen (1986) used simulation models to study liquidity costs and scalping returns in corn futures markets and found liquidity costs of .06 to .08 percent of contract values. Lower returns for corn may result from smaller contract values. A presumption may be warranted that scalpers want a certain level of return for time spent trading regardless of contract values and this might explain percentage differences between commodities. The execution costs for the commodities studied here fell in a wider range of .01 to .50 percent with Japanese yen, German mark, and Treasury bills below the range of Brorsen's study, and all remaining execution costs higher. Thompson and Waller (1987) found a liquidity cost for cocoa of $10.00 per contract and for coffee of $18.75 per contract, considerably lower than the $82.46 per contract execution cost found in our study. Possibly liquidity costs for some of the 11 commodities studied here are higher than those found in other studies but it is likely that part of the higher execution costs are accounted for by slippage.

Execution costs in terms of dollars per contract averaged $48.61. There was less variation between commodities on a dollar per contract basis with a low of $13.63 for world sugar and a high of $98.34 for gold. Treasury bills which were low for percentage execution costs were near the mean in dollar terms at $50.00, but heating oil which was the high in percentage terms remained high in dollar terms at $96.71. Execution costs as a percent of average margin requirements averaged 2.35 percent varying from .002 percent for coffee to 5.11 percent for heating oil.

Of 308 transactions, 107 had negative or zero execution costs, leaving 201 transactions with positive execution costs (Table II). Gold had a positive execution cost for 91 percent of transactions, but treasury bills had a positive execution cost for only 28 percent of transactions. In 74 percent of all transactions execution of the stop order was made with a single transaction. To some extent multiple execution depended on the size of orders, but there were instances of orders for as many as 64 contracts which were filled at a single price. Most multiple transactions involved positive execution costs, but some of the negative execution costs also resulted from multiple transactions.

The distribution of execution costs varied substantially by commodity. While the standard deviation in dollars per contract was $121.08 for all commodities, the standard deviation ranged from a low of $21.46 for soybean meal to a high of $157.66 for treasury bills. In terms of percentage of contract value, the standard deviation was .56 for all commodities with a range from .02 for treasury bills to 1.71 for heating oil. Similar results were found for execution costs as a percent of average margin requirements. For all contracts the standard deviation was 6.05 with a range from .003 for coffee to 14.97 for heating oil.

Figure 2 shows the distribution of execution costs in dollars per contract by commodity. Most of the commodities show a pronounced peak in the vicinity of zero execution costs and a decline as execution costs rise. However, for some commodities, such as, the Japanese yen, heating oil, gold, and coffee, there are significant outliers which give the distribution of execution costs a long tail. These outliers cannot be explained as arising from liquidity costs. The best explanation for significant outliers and negative execution costs is that they arise from slippage, not liquidity costs.

Figure 3 shows the distribution of execution costs as a percentage of the stop price for each commodity. The distributions show marked differences from those for dollar costs, particularly with much less pronounced peaking at the zero cost level and a wider scatter for positive execution costs. Again there are significant outliers which give the distribution of execution costs a long tail. Heating oil had such a large outlier it had to be shown on a different scale. However, treasury bills show almost no distribution on a percentage basis. Distributions for heating oil, platinum, and gold showed a tendency towards a more even distribution than was characteristic of the distribution of dollar execution costs.

The results of the least squares estimates are as follows with t-values in parentheses:

$$\begin{aligned}(5)\quad PCTEC = {} & \underset{(.761)}{.0502} + \underset{(2.610)}{.0000226*RANGE} + \underset{(.099)}{.000000307*VOLUME} \\ & \underset{(-.154)}{-.00968*BUY} + \underset{(2.409)}{.1604*NY} + \underset{(1.945)}{3.409*NCV}\end{aligned}$$

$$
\begin{aligned}
(6)\quad PCTMARG = {} & .01524 + .004487*RANMARG + .0000004123*VOLUME \\
& (2.405) \quad (2.599) \qquad\qquad (1.208) \\
& -.006236*BUY + .005961*NY + .2197*NCV \\
& (-.903) \qquad\quad (.815) \qquad\quad (.615)
\end{aligned}
$$

The model in equation (5) had R-Square of .0605 indicating that these variables showed little explanatory power for execution cost size. Only the coefficients for volatility (RANGE) and for location (NY) were significant at a 5 percent confidence interval. The model in equation (6) had R-Square of .0352 again indicating low explanatory value. Only the coefficients for the intercept term and the volatility variable (RANMARG) were significant.

Regressions for individual commodities had similar results with only the volatility variable having significant coefficients and relatively low explanatory power. Volume was never significant. For some commodities the buy-sell coefficient was important, but generally this resulted from the trading system taking a position with a execution cost which was exited with a market order to avoid further losses. For these commodities, the position was usually taken on one side of the market several times, resulting in a bias in execution costs for one side of the market. Results suggest that explanation of the size of execution costs is most likely to come from volatility measures, although there may be other volatility measures which are more explanatory than the one used here.

Summary and Conclusions

This paper determined the size of execution costs for stop orders in commodity futures markets and compares these costs and their distribution for several commodities. The research suggests that these execution costs are substantially higher than the scalping costs found for scalpers' returns in commodity markets. These differences can be explained by slippage since there are significant outliers which are unlikely to be explained by scalping costs. Further, there are important differences in the magnitude and distribution of execution costs between commodities and between execution costs measurements, such as, dollars per contract or percent of contract value.

Often technical trading systems and hedging strategies are developed and optimized without consideration of transactions costs, including brokerage commissions and execution costs. This research suggests such costs can be significant, but also vary across commodities. These added costs will have an adverse impact on expected results from such technical trading models if stop orders are used. While in general such costs may be small, the chance of a substantial execution cost on a transaction exists as can be seen by the large number of substantial outliers in the distribution of execution costs.

Execution costs should be considered in any research where stop orders are used. The substantial execution costs found for stop orders suggests problems in their usage. Electronic trading might be expected to result in lower execution costs on stop orders, but uncertainty over the cause of higher execution costs makes estimation of the potential gains difficult. Questions concerning market manipulation and actual trading practices may be answered if a better understanding of execution costs on stop orders can be obtained. For those who must make estimates of execution costs in their models and research the costs, estimated here are potentially usable. For other commodities, the researcher should look carefully at the market involved with regard to contract size, minimum price movement, and volatility before settling on a execution cost estimate.

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Table I. Distribution of Execution Costs for Stop Orders, by Commodity, for a Public Futures Fund, January 1975-March 1984.

Commodity	Mean	Minimum	Maximum	Standard Deviation
Execution Cost as a Percent of Stop Price:				
World Sugar	.21	-.26	2.01	.41
Coffee	.14	-.04	.81	.19
Pork bellies	.16	-.04	.61	.17
Soybean meal	.10	0.00	.38	.14
Heating oil	.50	-.09	8.66	1.71
Japanese yen	.04	-.02	.27	.07
German mark	.04	0.00	.37	.08
Treasury bills	.01	-.04	.08	.02
Copper	.17	-.07	.42	.16
Platinum	.43	-.13	1.65	.47
Gold	.27	0.00	1.55	.39
All	.18	-.26	8.66	.56
Execution Cost in Dollars per Contract:				
World Sugar	$13.63	-$11.20	$200.20	$33.71
Coffee	$82.46	-$22.50	$618.75	$133.11
Pork bellies	$41.15	-$12.00	$168.00	$43.75
Soybean meal	$14.34	0.00	$60.00	$21.46
Heating oil	$96.71	-$17.50	$1445.25	$238.19
Japanese yen	$27.42	-$12.50	$200.00	$45.69
German mark	$18.06	0.00	$162.50	$33.67
Treasury bills	$50.00	-$400.00	$700.00	$157.66
Copper	$25.70	-$11.36	$62.50	$24.15
Platinum	$77.92	-$17.86	$280.00	$85.68
Gold	$98.34	0.00	$630.00	$150.18
All	$48.61	-$400.00	$1445.25	$121.08
Execution Cost in Percent of Average Margin Requirements:				
World Sugar	1.72	-1.41	25.20	4.24
Coffee	.002	-.0005	.01	.003
Pork Bellies	1.75	-.51	7.15	1.86
Soybean Meal	1.46	0	6.10	2.18
Heating Oil	5.11	-.92	76.38	14.97
Japanese Yen	1.52	-.69	11.07	2.53
German Mark	1.23	0	11.03	2.29
Treasury Bills	2.55	-20.42	35.74	8.05
Copper	2.64	-1.17	6.42	2.48
Platinum	4.26	-.98	15.31	4.68
Gold	4.40	0	28.16	6.71
All	2.35	-20.42	76.38	6.05

Table II.--Descriptive Statistics for Stop Order Transactions, by Commodity, for a Public Futures Fund.

Commodity	Contract Size	Contract Units	Minimum Movement 1/	Average Size of Transaction	Total Number	Zero or Negative Costs	Multiple Executions 2/
World sugar....	112,000 pounds	cents/ pound	$11.20	9.5	44	22	15
Coffee...	37,000 pounds	cents/ pound	$3.75	7.6	30	3	10
Pork bellies..	40,000 pounds	cents/ pound	$9.50	17.9	28	6	9
Soybean meal.....	100 tons	$/ton	$10.00	21.8	11	7	1
Heating oil......	42,000 gallons	$/gallon	$4.20	21.3	25	4	14
Japanese yen......	12.5 mil. yen	$/yen	$12.50	6.5	31	15	0
German mark.....	125,000 marks	$/mark	$12.50	7.1	27	14	0
Treasury bills....	$1 mil.	pts. of 100%	$25.00	5.2	36	26	0
Copper...	25,000 pounds	cents/ pound	$12.50	24.6	26	5	14
Platinum.	50 troy ounces	$/troy ounce	$5.00	16.1	27	3	12
Gold.....	100 troy ounces	$/troy ounce	$10.00	13.8	23	2	6
All......	-	-	-	12.6	308	107	81

1/ Minimum price movement in dollars per contract.

2/ Number of transactions that required trades at more than one price to complete execution of the order (all such transactions have execution and liquidity costs).

Figure 1.--Components of Transactions Costs for Contracts on Futures Markets.

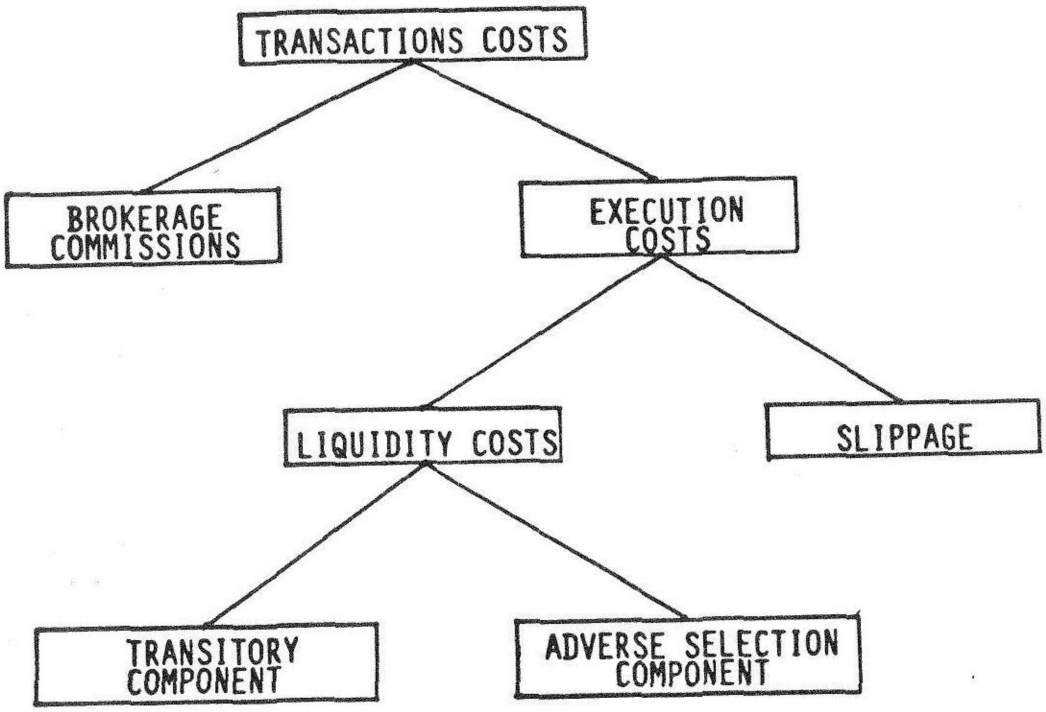

Figure 2.--Distribution of Execution Costs in Dollars per Contract, by Commodity, for a Public Futures Fund.

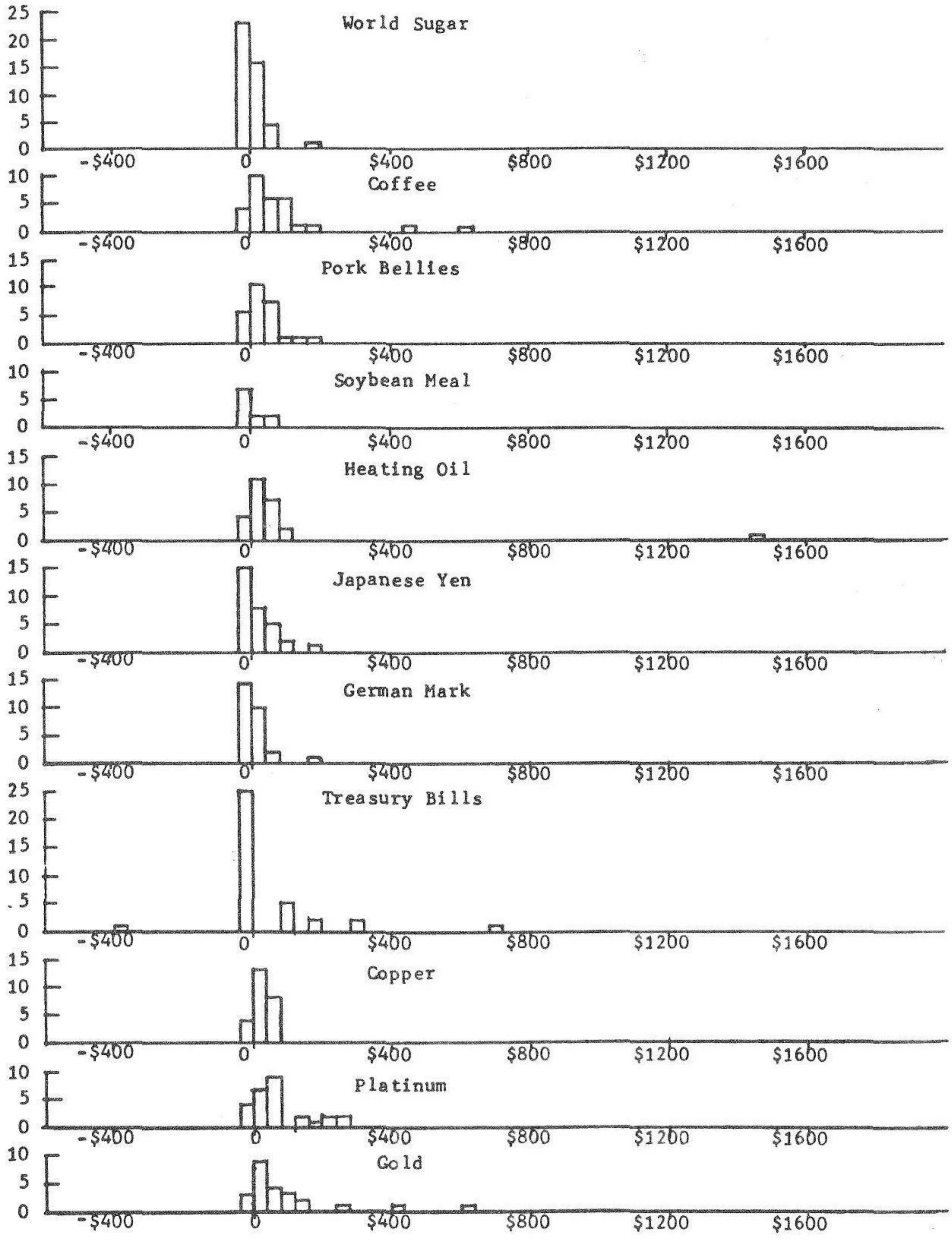

Figure 3.--Distribution of Execution Costs as a Percent of Stop Price, by Commodity, for a Public Futures Fund.