FIGURE 1

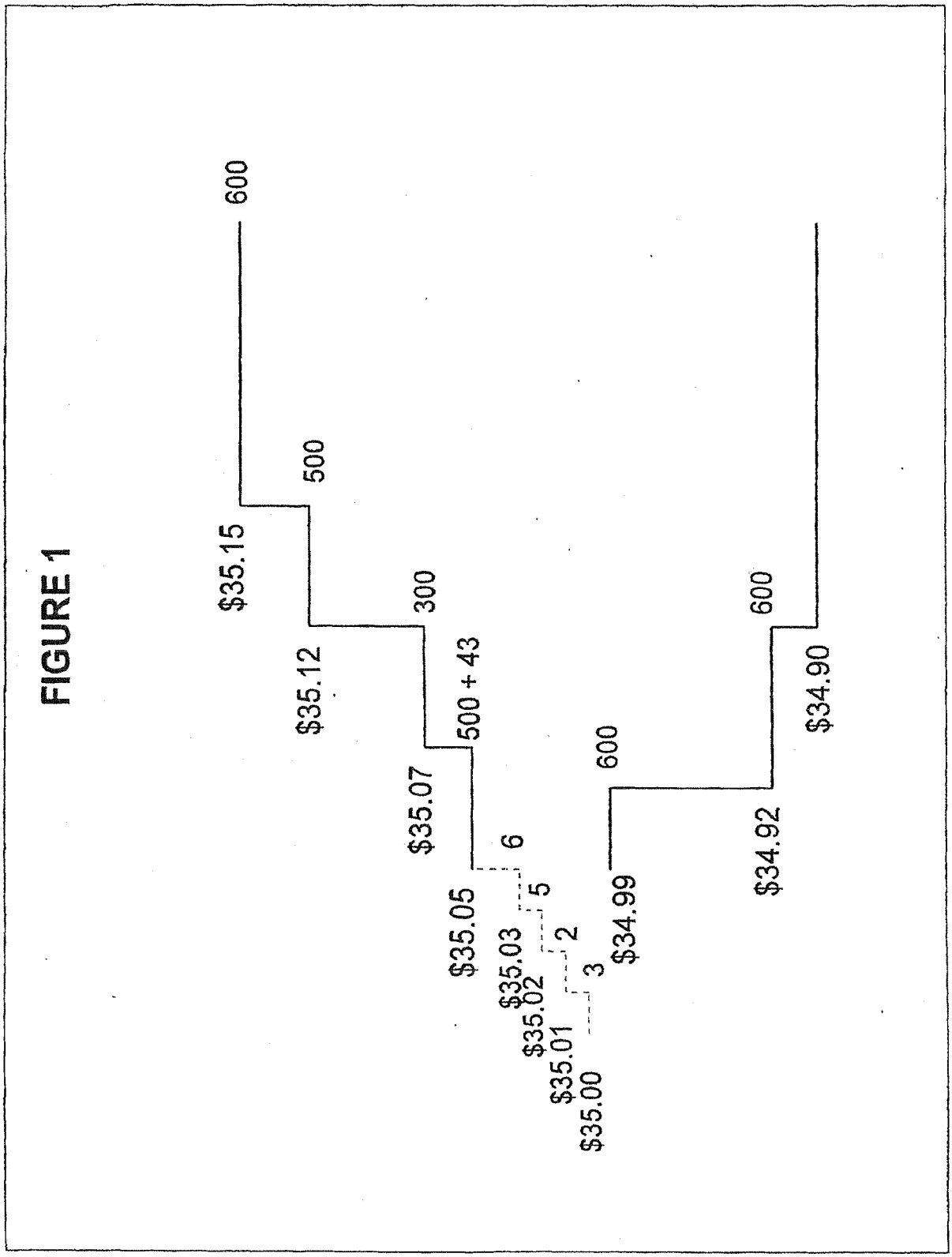
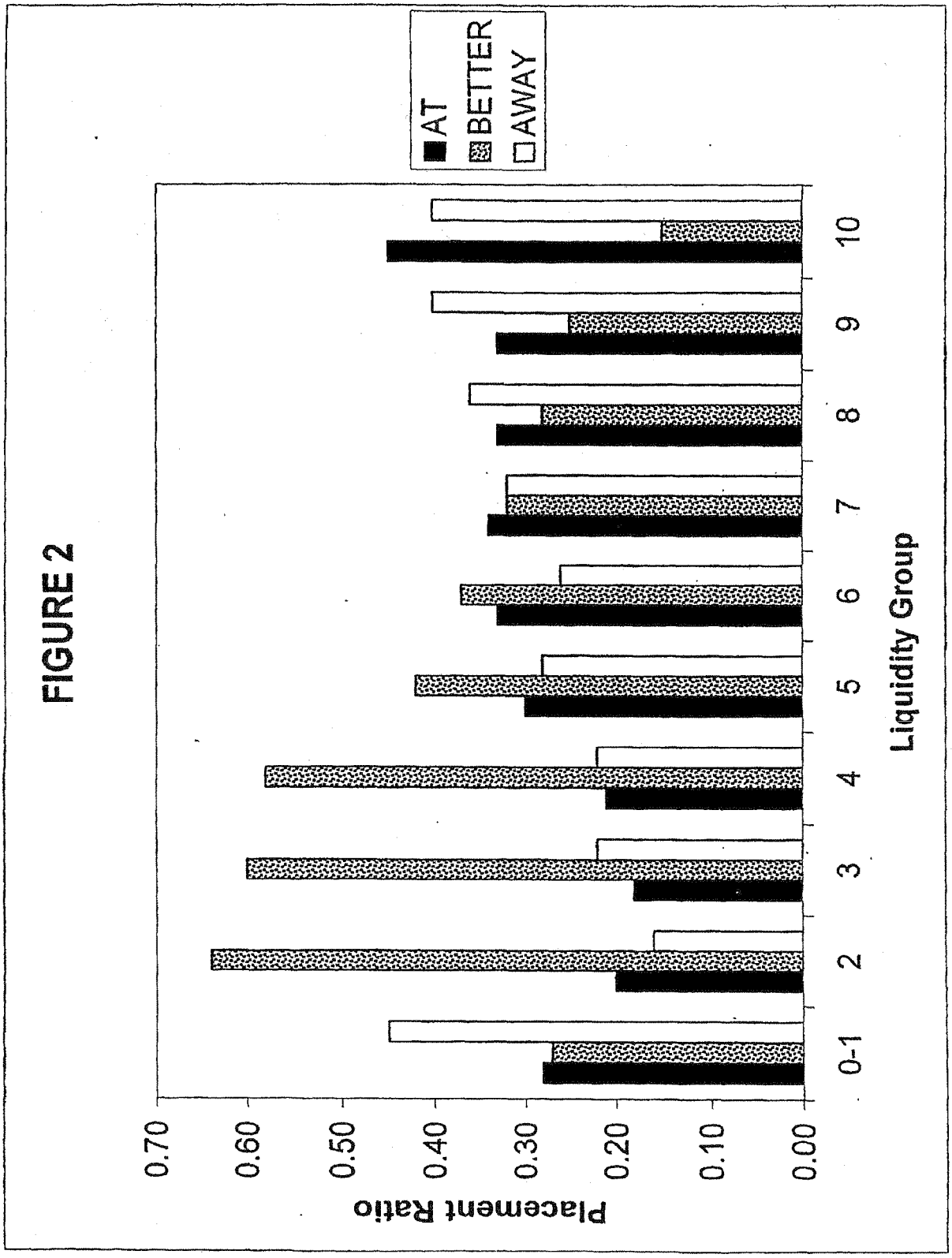

600
$35.15
500
$35.12
300
500 + 43
$35.07
6
$35.05
5
$35.03
2
$35.02
3
$35.01
$35.00
600
$34.99
600
$34.92
$34.90

FIGURE 2


AT
BETTER
AWAY
Placement Ratio
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0-1
2
3
4
5
6
7
8
9
10
Liquidity Group

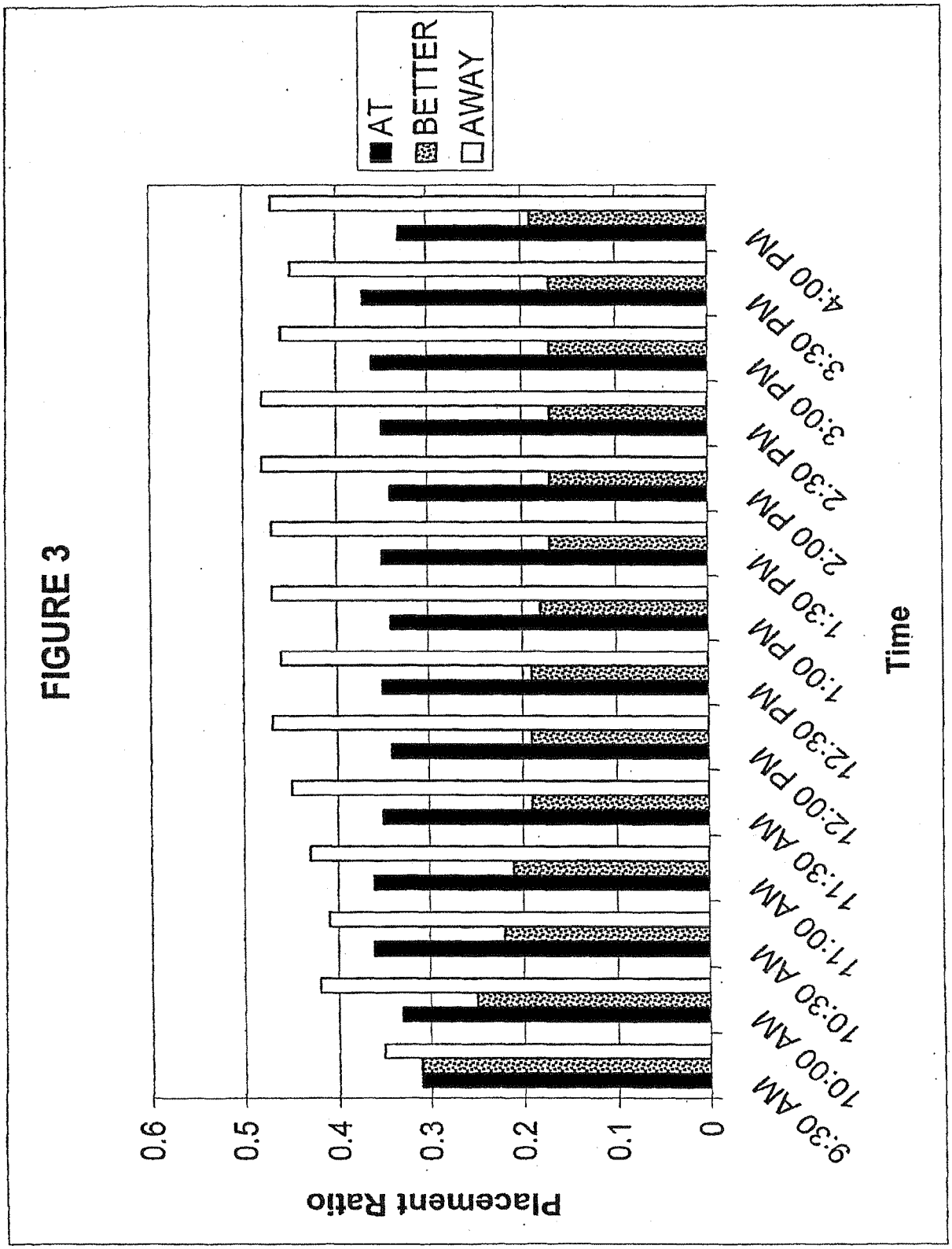

AT
BETTER
AWAY
Placement Ratio
0.6
0.5
0.4
0.3
0.2
0.1
0
Time
9:30 AM
10:00 AM
10:30 AM
11:00 AM
11:30 AM
12:00 PM
12:30 PM
1:00 PM
1:30 PM
2:00 PM
2:30 PM
3:00 PM
3:30 PM
4:00 PM

FIGURE 3

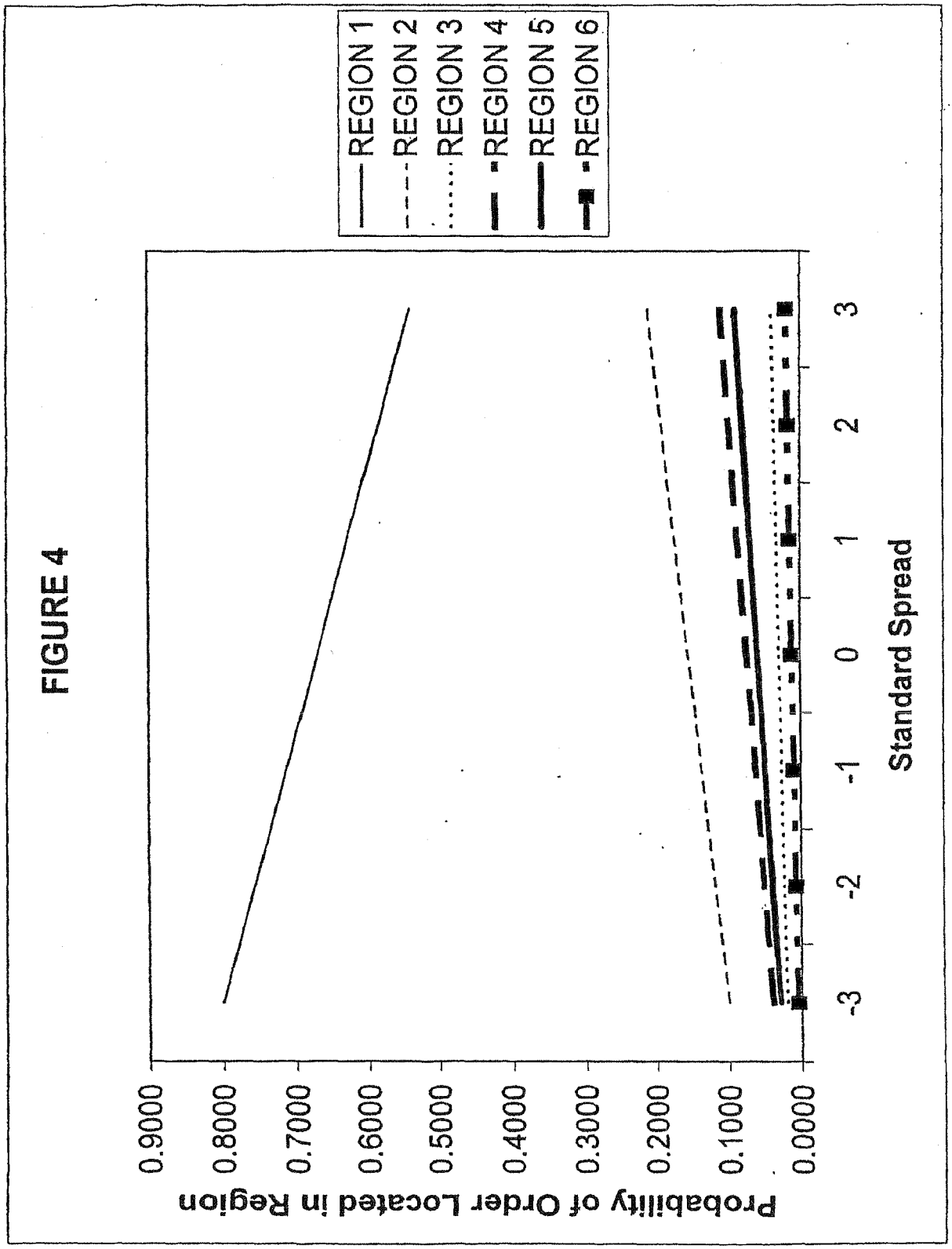

REGION 1
REGION 2
REGION 3
REGION 4
REGION 5
REGION 6
Probability of Order Located in Region
0.9000
0.8000
0.7000
0.6000
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
-3
-2
-1
0
1
2
3
Standard Spread

FIGURE 4

FIGURE 5

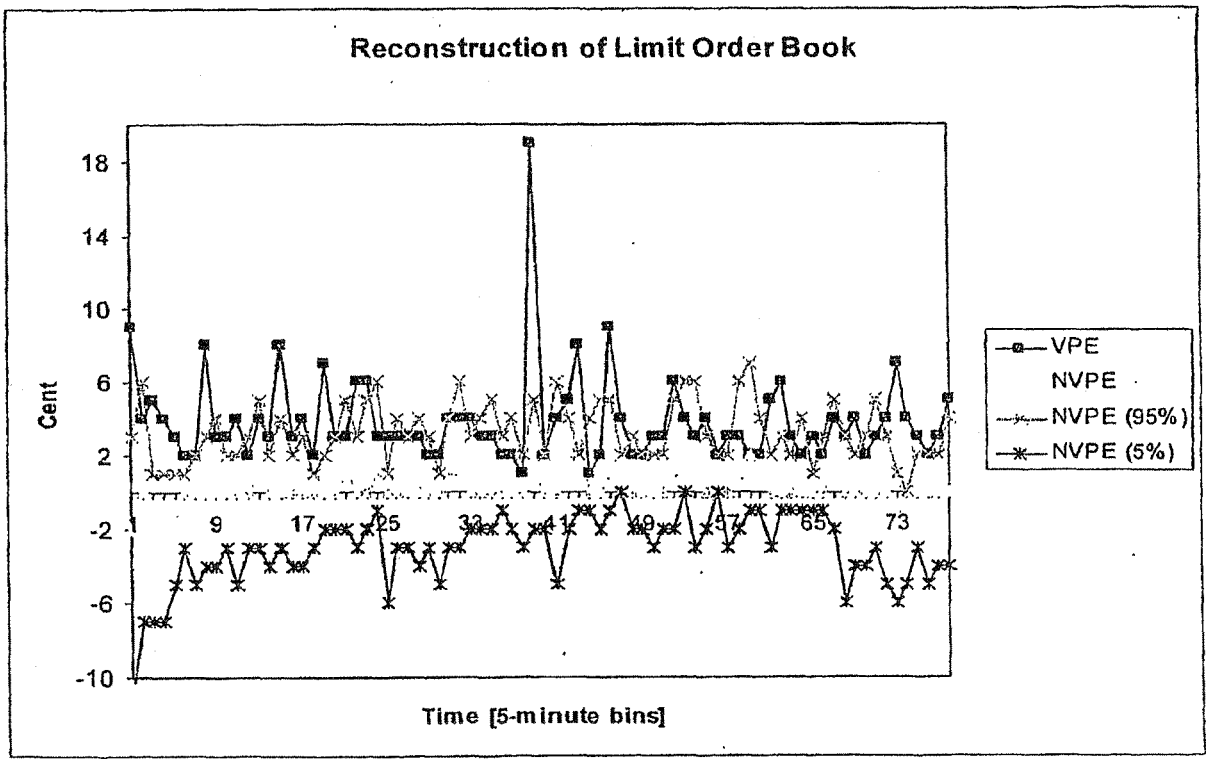
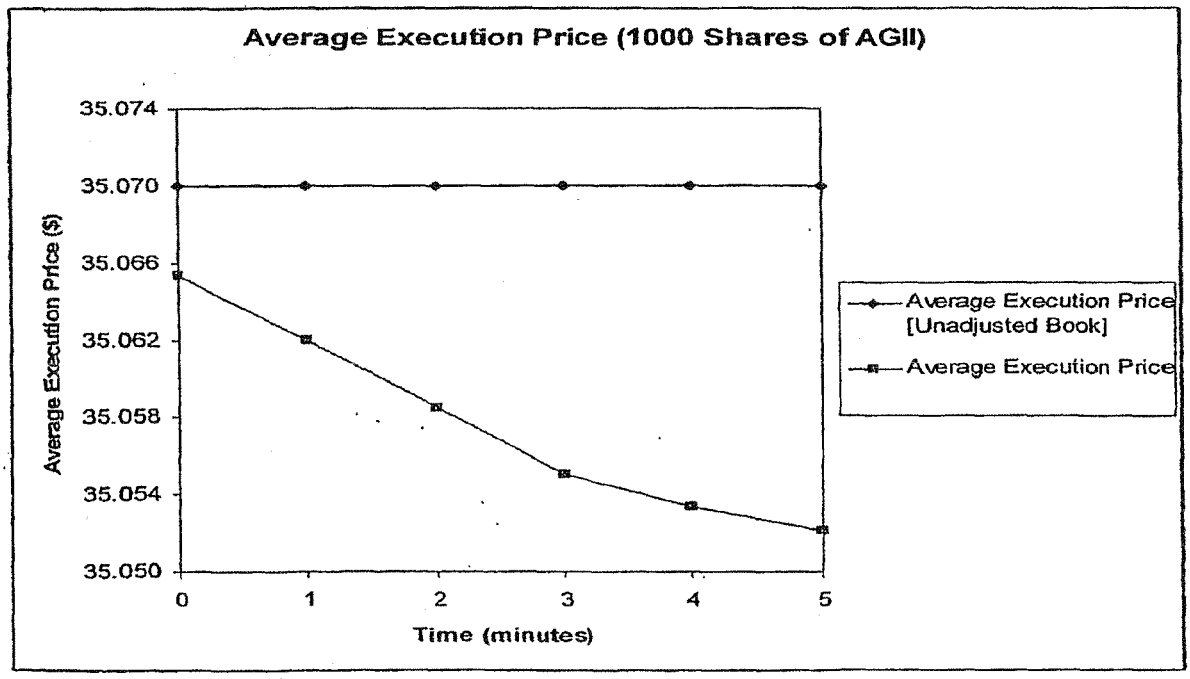

Reconstruction of Limit Order Book
Cent
18
14
10
6
2
-2
-6
-10
1
9
17
25
33
41
49
57
65
73
Time [5-minute bins]
VPE
NVPE
NVPE (95%)
NVPE (5%)

FIGURE 6


Average Execution Price (1000 Shares of AGII)
35.074
35.070
35.066
35.062
35.058
35.054
35.050
Average Execution Price ($)
0
1
2
3
4
5
Time (minutes)
Average Execution Price [Unadjusted Book]
Average Execution Price

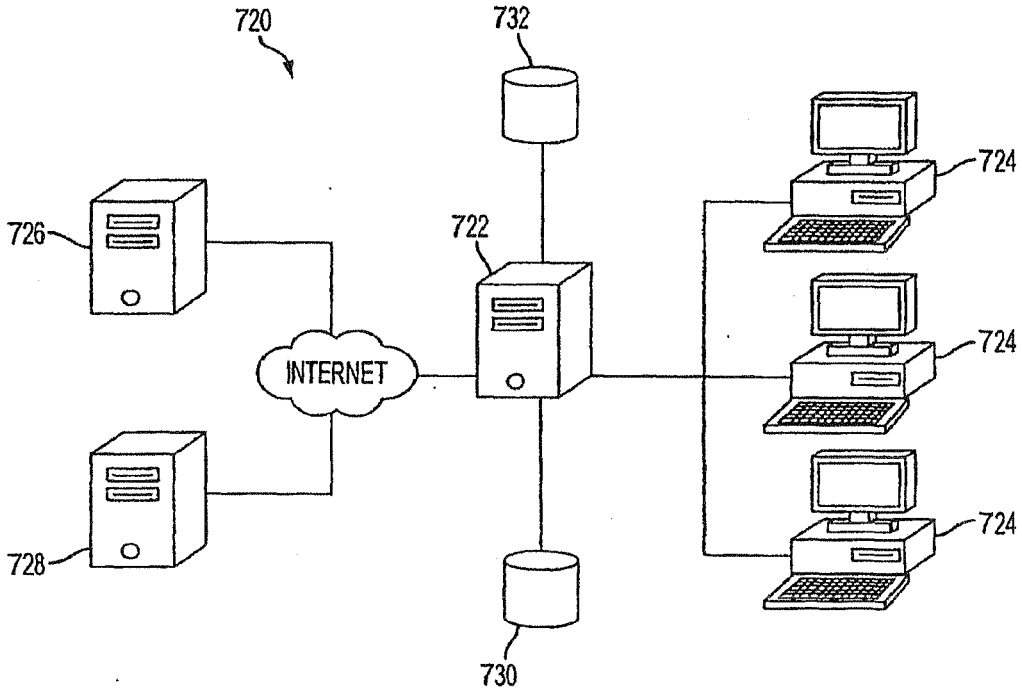


FIG. 7

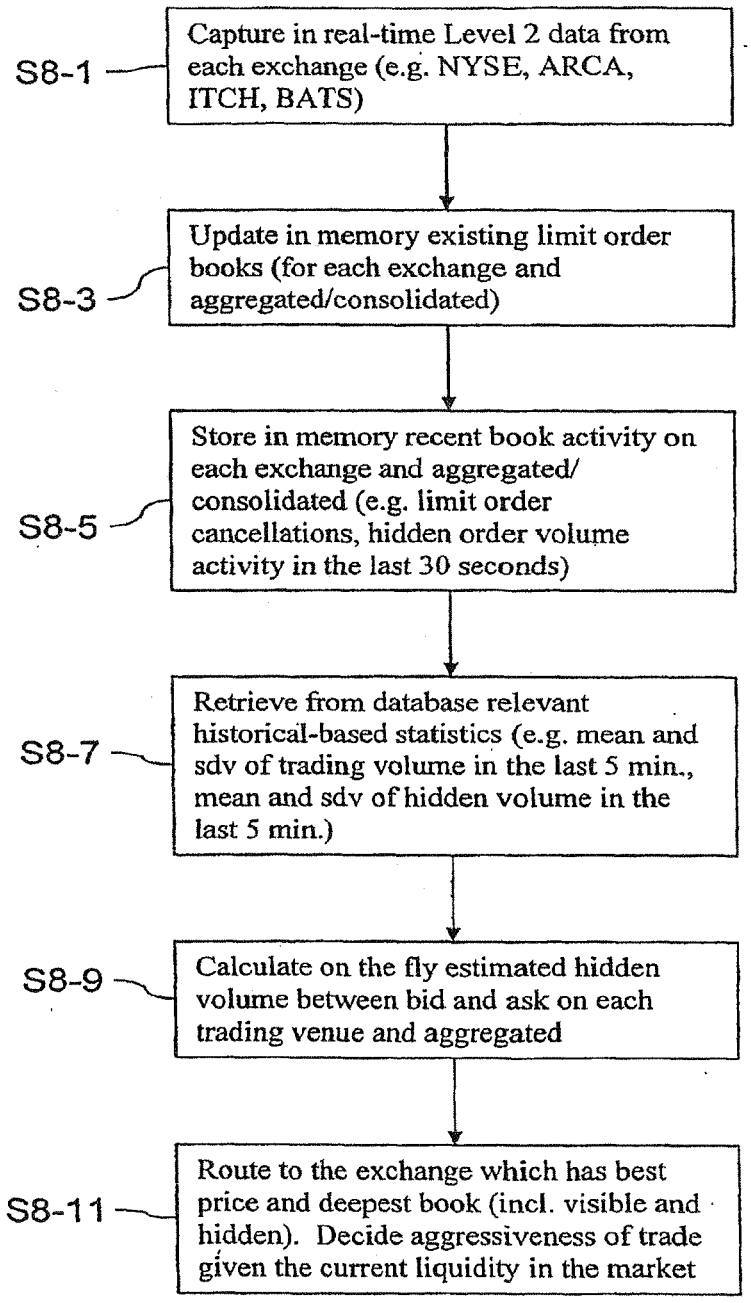

S8-1
Capture in real-time Level 2 data from each exchange (e.g. NYSE, ARCA, ITCH, BATS)
S8-3
Update in memory existing limit order books (for each exchange and aggregated/consolidated)
S8-5
Store in memory recent book activity on each exchange and aggregated/ consolidated (e.g. limit order cancellations, hidden order volume activity in the last 30 seconds)
S8-7
Retrieve from database relevant historical-based statistics (e.g. mean and sdv of trading volume in the last 5 min., mean and sdv of hidden volume in the last 5 min.)
S8-9
Calculate on the fly estimated hidden volume between bid and ask on each trading venue and aggregated
S8-11
Route to the exchange which has best price and deepest book (incl. visible and hidden). Decide aggressiveness of trade given the current liquidity in the market

FIGURE 8

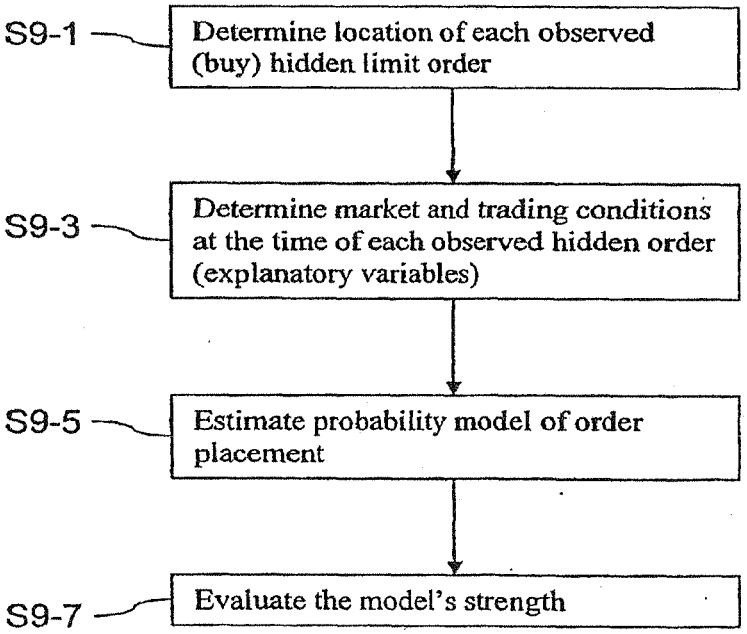

S9-1
Determine location of each observed (buy) hidden limit order
S9-3
Determine market and trading conditions at the time of each observed hidden order (explanatory variables)
S9-5
Estimate probability model of order placement
S9-7
Evaluate the model's strength

FIGURE 9

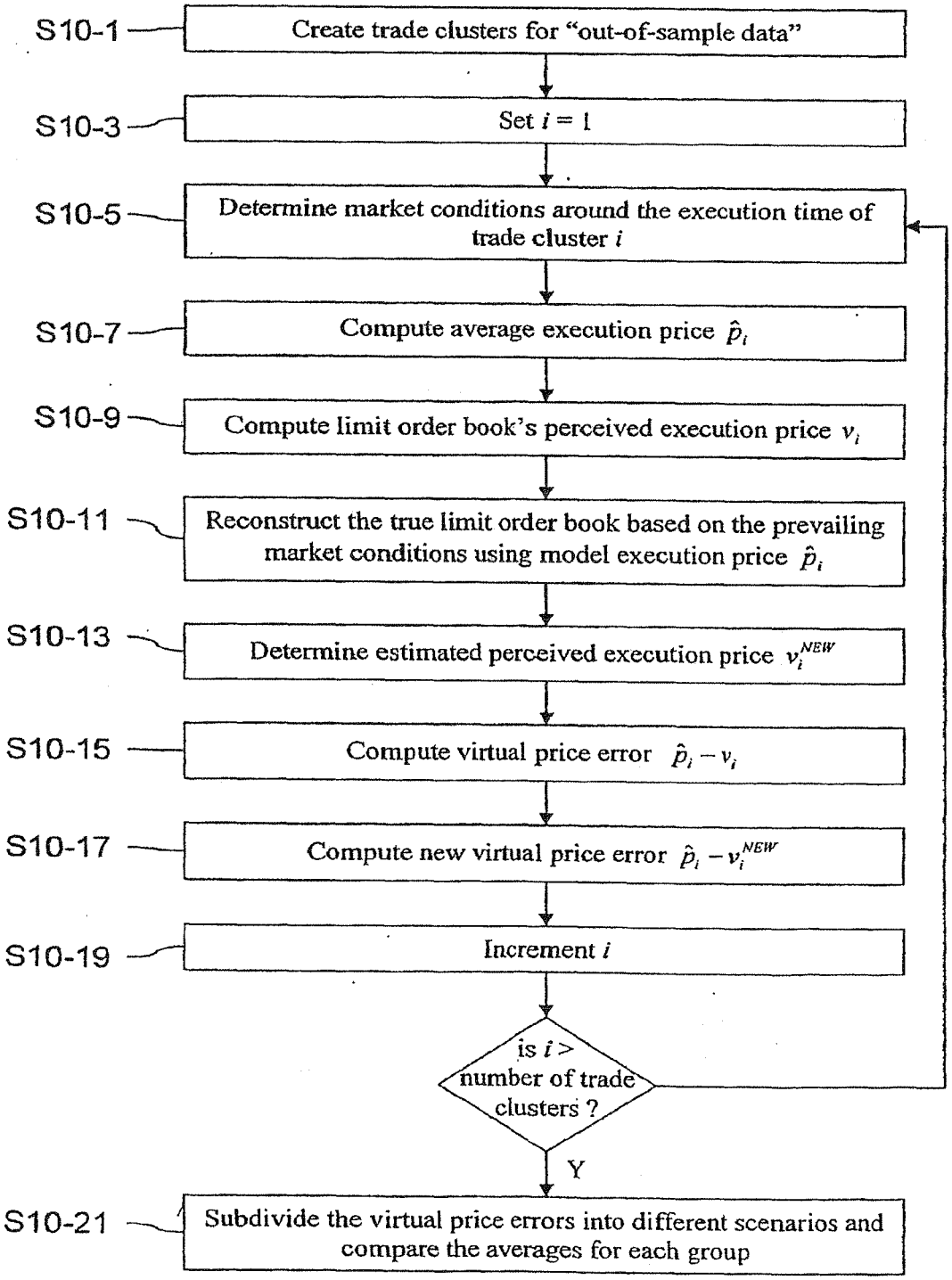

S10-1
Create trade clusters for "out-of-sample data"
S10-3
Set $i = 1$
S10-5
Determine market conditions around the execution time of trade cluster i
S10-7
Compute average execution price $\hat{p}_i$
S10-9
Compute limit order book's perceived execution price v_i
S10-11
Reconstruct the true limit order book based on the prevailing market conditions using model execution price $\hat{p}_i$
S10-13
Determine estimated perceived execution price v_i^{NEW}
S10-15
Compute virtual price error $\hat{p}_i - v_i$
S10-17
Compute new virtual price error $\hat{p}_i - v_i^{NEW}$
S10-19
Increment i
is $i >$ number of trade clusters ?
Y
S10-21
Subdivide the virtual price errors into different scenarios and compare the averages for each group

FIGURE 10

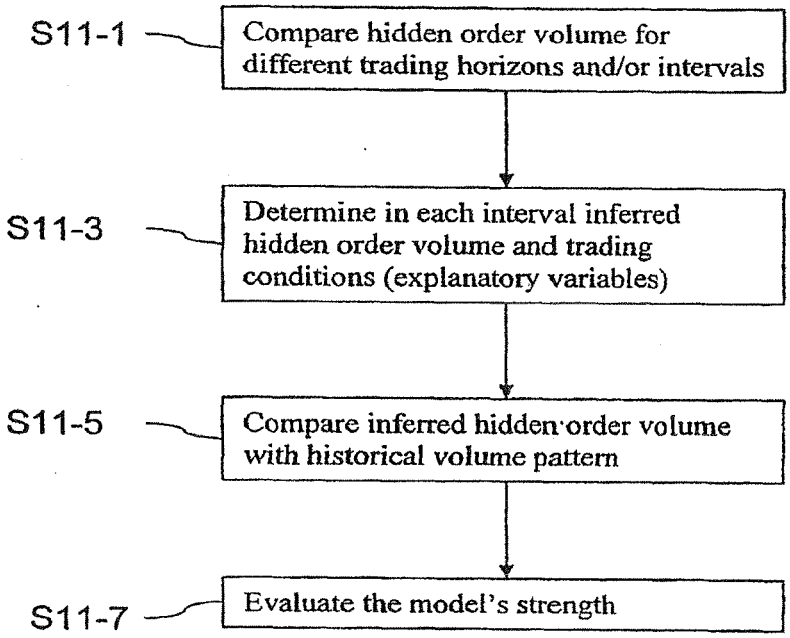

S11-1
Compare hidden order volume for different trading horizons and/or intervals
S11-3
Determine in each interval inferred hidden order volume and trading conditions (explanatory variables)
S11-5
Compare inferred hidden order volume with historical volume pattern
S11-7
Evaluate the model's strength

FIGURE 11

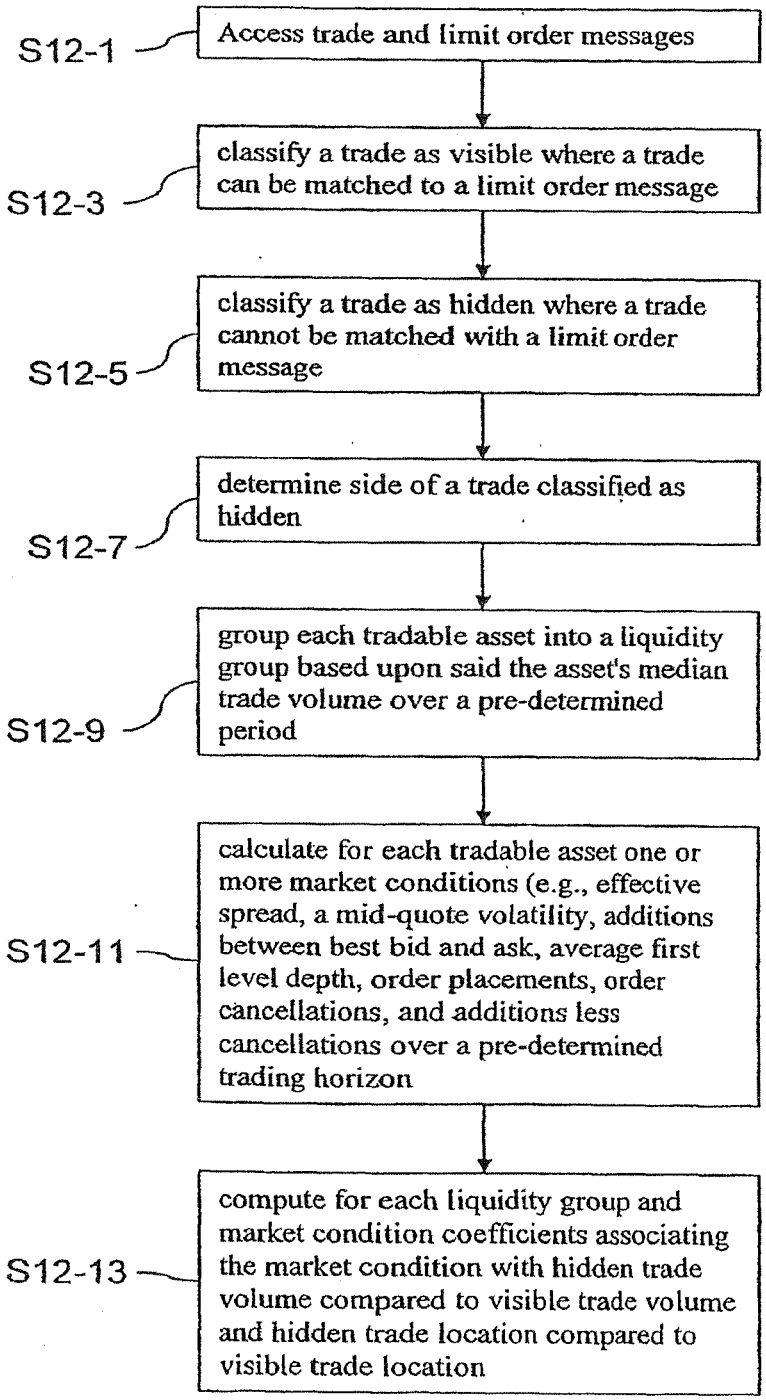

S12-1
Access trade and limit order messages
S12-3
classify a trade as visible where a trade can be matched to a limit order message
S12-5
classify a trade as hidden where a trade cannot be matched with a limit order message
S12-7
determine side of a trade classified as hidden
S12-9
group each tradable asset into a liquidity group based upon said the asset's median trade volume over a pre-determined period
S12-11
calculate for each tradable asset one or more market conditions (e.g., effective spread, a mid-quote volatility, additions between best bid and ask, average first level depth, order placements, order cancellations, and additions less cancellations over a pre-determined trading horizon
S12-13
compute for each liquidity group and market condition coefficients associating the market condition with hidden trade volume compared to visible trade volume and hidden trade location compared to visible trade location

FIGURE 12