Research Paper　　　　　　　　　　　　　　　　**Finance**

THE ADVERSE SELECTION COST COMPONENT OF SHARES TRADED AT THE NATIONAL STOCK EXCHANGE OF INDIA

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KEYWORDS :

I. Introduction

Liquidity reflects the financial health of a market. Bid Ask Spread is one of the important measures of liquidity. It is also an indicator of the financial stability of the stock markets. It arises as the compensation for various costs involved when trading in securities. These costs are classified as Order Processing Costs, Inventory Holding Costs and Adverse Selection Costs.

Two categories of markets exist – the order driven market and the quote driven markets. Quote driven markets have a third party or the dealers who provide liquidity. But in case of the order driven markets, liquidity is provided by limit orders. The order processing cost arises when a transaction takes place.　Processing of orders and execution of these orders results in cost to the investor which cannot be avoided and hence a part of total market prices.

While the order processing costs are fixed, the inventory holding costs is incurred when the investor is not clear about the order flow , both in terms of quantity and time of the order. This forces him to hold a portfolio, which is not optimal. He bears cost in holding unoptimal shares, which could have been invested in other avenues. This results in inventory holding costs. The inventory holding cost is expected to be minimal for an order driven market and therefore not too important for order driven markets.

The adverse selection cost is one of the most researched and important component of the bid ask spread. Information based trading can create a huge difference in market prices. A few investors would receive information before the rest of them receive the same information. This leads to information asymmetry. Informed traders place orders according to the information they receive. This would cause adverse selection risk. This adverse selection risk is borne by market makers in the quote driven markets and limit order trades in the order driven markets (Handa and Schwartz, 1996).

As explained by various theories in financial markets, different investors receive information at different points in time and at various levels. Some traders are hence, better informed than the others.　A better informed trader will buy when the stock　is undervalued and sell when the stock is overvalued. Here, the liquidity providers loses, faces liquidity risk and hence, they seek for compensation. This type of costs arises in case of informational event and was first given by Bagehot(1971).

The order processing cost and the inventory holding costs are transitory in nature as it is not information driven. These costs cause the prices to mean revert or price changes to be negatively serially correlated. But the adverse selection cost is permanent in nature. The effect on prices does not revert in future. This is due to informational nature of the adverse selection costs.

Like some developed markets, the Indian　stock exchanges do not have a dealer or market maker. In such cases, the bid ask spread must be estimated from trade prices. The trade prices can be obtained from the National Stock Exchange of India Ltd, on request.　Trade prices consists of tick by tick transaction data and it is possible to calculate the bid ask spread from the trade prices.

The purpose of this paper is to examine the components of the bid ask spread in a limit order market. Existing theories on components of spread have focused on developed markets and on quote driven and

dealer markers. However, the bid ask spread is not unique to the dealer markets. Cohen, Aier, Schwartz and Whitcomb (1981) establish the existence of bid ask spread in a limit order market when investors faces transaction costs of assessing information, monitoring markets and conveying orders to the markets. Glosten (1994) shows that the limit order market will have a positive bid ask spread arising from the possibility of trading on private information. However, empirical research on the components of the bid ask spread is limited in a limit order market like India.

I examine the components of bid ask spread, particularly the adverse selection cost component for shares traded at the National stock Exchange of India. The remainder of this paper is organized as follows. Section 2 brings out a brief literature on this subject. Section 3 describes the set up i.e. the market on which this research is carried out. Section 4 represents empirical results and Section 5 concludes.

II. Literature Review

Kyle (1985) was one of the forerunners in establishment of the components of spread. He argues that the presence of traders who possess superior knowledge of the value of a stock can impose adverse selection costs on liquidity traders and market makers. The theoretical contribution on the components of bid ask spread is immense. Roll's (1984) serial covariance of observed transaction prices was one of the first. The others who followed the serial covariance properties were Choi, Salandro and Shastri (1984), George, Kaul and Nimelandran (1991), Stoll (1989), Lin (1992), Huang and Stoll (1994), Lin, Sanger and Booth(1995). Few other contributions based on the trade initiation indicator model included Glosten and Harris (1988), Madhavan and Smidt (1991).

A major contribution was made by Madhavan, Richardson and Roomans (1997) (henceforth MRR). The MRR model is more suitable for order driven markets. It is an extension of the Glosten and Milgrom (1985) model. In the MRR model, the inventory component is ignored. Instead, the model decomposes the spread into permanent component due to information (adverse selection) and transitory component. This approach has an attractive feature since it is believed that the inventory costs are of a less important concern for limit order trades.

III. Data and Methodology

The National Stock Exchange of India (henceforth NSE) was incorporated in 1992 and was recognized as a stock exchange in 1993. It is a completely order driven electronic market. NSE operates in different segments - Capital Market, wholesale Debt Market, Futures & Options and Currency.

Capital market segment offers a screen based trading system for equities, preference, shares, Exchange traded funds, retail government securities etc. The trading platform known as NEAT (National Exchange for Automated Trading) operates on a price/time priority basis. The sample consists of a random of 400 shares that were traded on the NSE from July to September 2014.   The data was collected from NSE – Department of Economic Analysis and Policy (NSE – DEAP). On request, the NSE provides the required data for all trading activities. The average measure for each stock for each day is first calculated for the entire month. Thus a summary measure per security for the stock is obtained.

The actual spread, being the difference between the ask and bid prices

is based on bid and ask quotes, which can be obtained from the Limit Order Book (LOB). The NSE collects snapshot of LOB at four different times of a trading day – at 11 AM, 12 Noon, 1 PM & 2 PM. Snapshot and trade data are used for this study. The LOB snapshot lists all the outstanding orders, identified as buy/sell orders. On the data obtained, the MRR model was used to estimate the components of the spread.

The MRR model:
According to the MRR model, the price of a security at time t is given by P_t. Q_t is the buy-sell trade indicator variable for transaction prices. Q_t takes the value of 1 if it is a buyer initiated transaction and –1 if it is a seller initiated transaction. The change in transaction price is given as

$$\Delta P_t = \alpha(Q_t - \rho Q_{t-1}) + \beta(Q_t - Q_{t-1}) + \mu_t$$

The first term captures the effect of revision in belief, where $\alpha \geq 0$ measures the possible asymmetric information revealed by the trade at time t. The second term captures the effect of bid ask bounce where $\beta \geq 0$ denotes the liquidity suppliers' cost per share for supplying liquidity.

The three parameters (α, β and ρ) governing the behavior of transaction prices and quotes in the equation can be estimated using generalized method of movements (GMM) which imposes very weak distribution assumptions. This is important because the error term includes the rounding errors due to discreteness of stock prices.

IV. Analysis of data
Shares of 400 randomly selected companies are taken for analysis. These companies are classified according to their market prices and in ascending order; they are classified under four categories. The first category consists of the shares with the lowest market prices, in the range between Rs. 50 and 250. The second quartile consists of shares whose market prices are between Rs. 251 and 400. The third quartile consists of shares having a range of market prices between Rs.401 and 2000. The last quartile consists of companies having a market price above Rs. 2000. The descriptive values are given in Table 1. It is seen that the average market price of shares of the first quartile is Rs. 125. Low priced stocks are included here. Shares which had a market price of below Rs 50 are ignored. The average MPS for the second quartile is Rs. 576, for the third quartile, it is Rs.1538. The forth quartile consists of an average market price of Rs. 2925. Most of the stock which form the Sensex and the Nifty, which are the most liquid, have average market prices between Rs. 2000 and Rs. 3000. The return volatility for these shares represents the variations in market prices. The return volatility is calculated for the trading prices of the past one year. It is the average value for past one year. The implied spread for these shares is found to be 4.35, 2.71, 1.63 and 1.39 respectively. The spread is lowest for shares belonging to the fourth quartile. This result shows an inverse relationship between market price and spread. The percentage spread which is the ratio between the market prices and the implied spread is lowest for the third quarter.

Table 2 provides the cross – sectional mean estimates of the market variables for the ten half-an hour intraday intervals through the trading day. For all four quarters, the number of shares traded, the market price per share, the market value and the return volatility are given. It can be seen that these values represents a U shape over the course of the trading day. It is seen that the return volatility also exhibit an inverted U shape. The number of shares traded at the beginning of the day is very low and slightly increasing as the day goes by. For the second quartile, the market prices are slightly increasing through the trading day. It is highest during the second last intraday half hour interval. Return volatility exhibits an inverted U pattern through the

trading day. For the trading on the third quarter, no particular pattern can be formed. Market value is lowest during the commencement of the trading session. The return volatility is lowest in the middle half hour interval.

Table 3 summarizes the intraday patterns of the bid ask spread for shares sorted by the four price categories. The average spread for shares belonging to the first quartile is 4.2. Spread is lowest during the post lunch session and highest during the second interval. It is seen that for the fourth quartile, the market value and the return volatility are the lowest and gradually increases over the trading day. The first quartile of Table 3 shows that the spread exhibits a "U" shaped pattern. Spread is high during the commencement of the session and decreases during the mid day. It again increases during the post lunch session.

Table 4 presents the summary statistics on the individual parameter estimates for four quarters of stocks. The summary also includes mean coefficient estimates, mean standard error, standard deviation of the estimates and the median estimates for the adverse selection cost component (α), order processing cost (β), auto correlation of order flows (ρ), implied spread, given as $2(\alpha + \beta)$ and the proportion of the adverse selection cost component. The adverse selection cost component, the order processing cost and the implied spread in percentage terms is calculated relative to the average prices over the sample period. For the first quartile it is seen that the mean adverse selection cost is 2.50. The order processing cost is almost equal to the ASC, at 2.044. For the second, third and fourth quartile, the adverse selection cost and the order processing cost have declined. It is also seen that the auto correlation of trade directions and the implied spread has declined. Hence, this Table justifies the conclusion that as the market prices increase, the adverse selection cost, the order processing cost and the spread decreases. An inverse relationship between the two variables.

It can be seen from Table 5 that the spread, the adverse selection cost component and the auto correlation of trade flow has the highest value during the beginning of the trading session. These values decline over the trading day reaches a lowest level during the mid day and increases during the last few sessions. Therefore spread and the components of spread exhibits a " U" shaped pattern. It can also be seen that as the market prices increases, the spread declines, showing an inverse relationship between spread, its components and the market prices. Shares with higher market prices are supposed to be more liquid, thus exhibiting lower values for components of spread.

V. Conclusion
This paper examines the components of the bid ask spread of 400 shares listed at the National Stock Exchange of India. Both the Adverse Selection Cost and the Order Processing Cost exhibits a "U" shaped pattern in the implied spread. The "U" shaped pattern is seen in most of the markets. (Example, Van Ness and Van Ness (1999), Madhavan, Richardson and Roomans (1997)). The findings also suggest that as the market prices increases, the spread and its components declines. This shows an inverse relationship between spread and market prices.

Table 1. Descriptive Statistics
This Table presents the descriptive statistics for 400 shares listed in the NSE. The summary includes share price, market value, return volatility, calculated over last one year, average number of trades per day, average trade volume, trade size etc. The shares are placed in ascending order based on the market prices and divided into four quarters. The first quarter consists of shares with the lowest market prices and the last quarter consists of shares with highest market prices.

	Quarter 1			Quarter 2			Quarter 3			Quarter 4		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
MPS (in rupees)	125	98	351	576	688	454	1538	1562	228	2925	3589	2832
Market Value (in crs)	444	545	1095	241	301	379	3212	4738	361	16516	834768	740
No. of Trades	5892	1882	1562	38402	40135	2884	703135	256272	18438	65629	775272	18887
No. of shares (in Crs)	15412	15832	4411	731285	78273	20055	1964	20843	2759	11334	15724	2599
Trading Volume (Crs)	5927	6280	3393	75668	82456	4419	134824	138759	19832	384339246	462441585	13092
Return Volatility	5.10	5.25	2.89	14.25	17.68	4.23	22.5	23.8	16.19	3.98	4.34	3.72
Spread	4.35	4.99	2.23	2.71	2.89	3.45	1.63	1.86	2.08	1.39	2.84	7.35
% Spread	0.45	0.58	0.39	0.31	0.38	0.06	0.34	0.33	0.12	0.12	0.09	0.31

Table 2. Mean Estimates of Variances and Trading Activity Variables on 30- Minutes Intervals
This Table presents the cross sectional mean estimates of the variance of transaction price changes, average number of trades, average rupee volume and the trade sizes during the 30 minute intraday intervals. The results are presented in four panels, based on their market prices.

Quartile 1

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15	Mean
Market Price per Share (in rupees)	124	124	125	127	129	132	133	133	122	124	126
Number of shares('000)	14281	15489	15842	15115	15217	15394	15335	14982	14111	14724	14925
Market Value (in crores)	17.70	19.20	19.80	19.19	20.33	20.23	20.54	21.11	21.19	19.23	19.5
Return Volatility	5.2	5.43	5.61	5.1	5.4	4.97	4.56	R.44	5.12	5.14	4.71

Quartile 2

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15	Mean
Market Price per Share	543	572	576	544	531	568	571	593	608	607	572
No. of shares (in '0000)	73.12	72.28	73.28	73.11	71.26	72.17	73.71	74.12	74.81	74.11	72.04
Market Value (in crores)	397.08	413.82	422.13	397.76	378.61	391.81	402.54	438.81	457.21	449.90	417.82
Return Volatility	14.25	14.83	14.77	15.38	15.01	15.12	15.01	14.89	14.52	14.72	14.7

Quartile 3

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15	Mean
Market Price per Share	1542	1548	1531	1548	1546	1523	1499	1497	1505	1515	1527.6
No. of shares (in '0000)	1946	1948	1954	2008	2015	2018	2181	2121	1998	2017	2011
Market Value (in crores)	3002.02	3017.03	3002.06	3037.19	3107.62	3070.58	3270.32	3192.7	3027.45	3080.37	3060.54
Return Volatility	4.48	4.76	4.32	4.11	4.18	4.24	4.17	4.23	4.19	4.19	4.25

Quartile 4

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15	Mean
Market Price per Share	2925	2876	2981	2998	3004	3018	3047	3092	2999	2874	3001
No. of shares (in 'lakhs)	65.62	72.43	79.84	84.72	85.49	84.11	89.29	81.91	79.24	78.42	79.97
Market Value (in crores)	1.919	2.083	2.380	2.540	2.568	2.539	2.72	2.57	2.408	2.264	2.4
Return Volatility	3.4	4.5	3.86	4.11	4.72	3.98	3.45	3.76	4.11	4.84	3.58

Table 3– Mean Rupee and Percent Spread by 30 minutes intraday trading intervals
This Table presents the cross sectional means estimates of the spread in rupee and percent terms, during a 30 minute intervals. The trading day is divided into intervals of 30 minutes over the trading day.

Quartile 1

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.40	14.40-15	Mean
Rupee Spread	4.22	4.68	4.18	4.24	4.15	4.25	4.40	4.22	4.09	4.1	4.2
Percent Spread	0.52	0.52	0.45	0.44	0.47	0.46	0.48	0.52	0.51	0.52	0.48

Quartile 2

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.40	14.40-15	Mean
Rupee Spread	2.71	2.64	2.18	2.11	2.03	2.1	2	1.9	2.14	2.32	2.3
Percent Spread	0.34	0.32	0.29	0.28	0.32	0.42	0.37	0.36	0.39	0.37	0.34

Quartile 3

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.40	14.40-15	Mean
Rupee Spread	1.64	1.72	1.54	1.59	1.68	1.59	1.62	1.61	1.64	1.62	1.65
Percent Spread	0.35	0.34	0.38	0.42	0.34	0.42	0.32	0.31	0.29	0.28	0.34

Quartile 4

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.40	14.40-15	Mean
Rupee Spread	1.87	1.42	1.68	1.43	1.32	1.44	1.29	1.28	1.43	1.42	1.47
Percent Spread	0.12	0.18	0.15	0.10	0.12	0.08	0.13	0.13	0.18	0.16	0.135

Table 4- GMM estimates of spread
This Table presents the GMM model estimates of the parameters and the spread implied by the parameters for 400 shares on the NSE. The parameters are the adverse selection cost (α), the order processing cost (β), and the auto correlation of trade direction (ρ). The implied spread is given as 2(α+β). The proportion of the adverse selection in the implied spread is given as γ. Shares are divided into four quartiles based on their market prices. The results of these four quartiles are summarized below.

Quartile 1

Particulars	Mean	Median	SE	SD
α	2.50	2.45	0.022	0.460
β	2.044	2.4	0.015	0.417
α(% of spread)	0.1027	0.112	0.0054	0.072
β(% of spread)	0.1826	0.1912	0.013	0.913
ρ	0.3116	0.3111	0.0056	0.324

γ	0.4875	0.5124	0.0126	0.213
Implied Spread	9.08	9.34	0.0815	1.928
Percentage of IS	0.5015	0.4526	0.0226	0.231

Quartile 2

Particulars	Mean	Median	SE	SD
α	1.49	1.35	0.274	2.13
β	1.27	1.09	0.1514	1.56
α(% of spread)	0.0116	0.012	0.086	4.232
β(% of spread)	0.093	0.081	0.0075	5.343
ρ	0.375	0.45	0.0152	0.929
γ	0.489	0.5q1	0.0512	0.912
Implied Spread	9.08	10.36	0.46	1.827
Percentage of IS	0.35	0.54	0.0169	0.11

Quartile 3

Particulars	Mean	Median	SE	SD
α	1.108	1.001	0.691	0.23
β	0.077	0.087	0.272	1.32
α(% of spread)	0.0913	0.121	0.025	0.91
β(% of spread)	0.0793	0.082	0.0167	0.45
ρ	0.3416	0.213	0.0052	0.034
γ	0.532	0.555	0.0164	0.099
Implied Spread	2.37	2.083	3.61	4 31
Percentage of IS	0.40	0.48	0.036	0.15

Quartile 4

Particulars	Mean	Median	SE	SD
α	0.390	0.379	1.028	0.435
β	0.460	0.420	0.678	0.234
α(% of spread)	0.0757	0.081	0.01	0.113
β(% of spread)	0.0504	0.045	0.0044	0.921
ρ	0.3563	0.367	0.0052	0.251
γ	0.467	0.465	0.0163	0.251
Implied Spread	1.70	1.67	3.61	2.165
Percentage of IS	0.4278	0.432	0.036	0.178

Table 5 – GMM model parameters and implied spread by for 30 minute intervals during the trading day.

This Table presents the cross sectional mean and the mean standard error (given in parenthesis) of the GMM model over the trading period. The day is divided into 10 30- minute intervals and for each interval, the adverse selection cost, the order processing cost, the auto correlation of trade flows and the implied spread are given. The companies are divided into four quartiles based on their market prices.

Quartile 1

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15
α (Rupee)	2.34 (.013)	2.38 (.038)	2.68 (.021)	2.66 (.019)	2.50 (.018)	2.68 (.015)	2.25 (.017)	2.19 (.028)	2.30 (.027)	2.21 (.025)
β (Rupee)	1.98 (.021)	1.543 (.018)	1.289 (.021)	1.728 (.011)	1.725 (.021)	1.835 (.018)	1.924 (.011)	2.011 (.013)	2.089 (.018)	2.523 (.017)
α (% of spread)	0.083 (.004)	0.097 (.005)	0.108 (.005)	0.101 (0.005)	0.120 (0.004)	0.118 (0.003)	0.103 (0.008)	0.105 (0.008)	.098 (0.007)	.097 (0.005)
β(% of spread)	0.182 (.0134)	0.176 (0.018)	0.243 (0.012)	0.204 (0.014)	0.175 (0.011)	0.168 (0.018)	0.167 (0.013)	0.162 (0.009)	0.168 (0.010)	0.181 (0.012)
ρ	0.343 (0.005)	0.298 (0.004)	0.301 (0.007)	0.310 (0.008)	0.324 (0.010)	0.311 (0.001)	0.328 (0.010)	0.297 (0.004)	0.296 (0.004)	0.308 (0.003)
γ	0.482 (0.013)	0.490 (0.010)	0.476 (0.009)	0.432 (0.011)	0.452 (0.012)	0.451 (0.014)	0.562 (0.018)	0.501 (0.017)	0.543 (0.017)	0.486 (0.013)
IS 2(α + β)	8.64 (0.083)	7.84 (0.084)	7.94 (0.068)	8.77 (0.071)	8.65 (0.081)	9.02 (0.082)	8.34 (0.088)	8.40 (0.087)	8.78 (0.085)	9.46 (0.076)
IS (% of Price)	0.530 (0.029)	0.485 (0.020)	0.479 (0.019)	0.483 (0.026)	0.483 (0.021)	0.472 (0.022)	0.469 (0.018)	0.529 (0.018)	0.541 (0.023)	0.544 (0.021)

Quartile 2

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15
α	1.32 (0.023)	1.40 (0.182)	1.48 (0.290)	1.47 (0.290)	1.38 (0.032)	1.32 (0.31)	1.24 (0.35)	1.29 (0.33)	1.34 (0.28)	1.39 (0.29)
β	1.38 (0.176)	1.34 (0.181)	1.38 (0.181)	1.29 (0.185)	1.28 (0.180)	1.24 (0.091)	1.22 (0.097)	1.27 (0.112)	1.28 (0.183)	1.25 (0.128)
α (% of price)	0.118 (.082)	0.0926 (0.089)	0.098 (0.092)	0.098 (0.078)	0.098 (0.79)	0.095 (0.091)	0.097 (0.128)	0.112 (0.1121)	0.156 (0.083)	0.158 (0.082)
β (% of price)	0.091 (.0008	0.098 (0.007)	0.092 (0.008)	0.100 (0.009)	0.108 (0.010)	0.106 (0.005)	0.084 (0.008)	0.82 (0.007)	0.078 (0.078)	0.091 (0.008)
ρ	0.384 (0.018)	0.381 (0.012)	0.389 (0.017)	0.365 (0.016)	0.353 (0.011)	0.395 (0.011)	0.359 (0.013)	0.377 (0.015)	0.382 (0.015)	0.370 (0.017)
γ	0.411 (0.054)	0.482 (0.056)	0.387 (0.052)	0.372 (0.055)	0.421 (0.052)	0.481 (0.051)	0.472 (0.049)	0.465 (0.054)	0.464 (0.049)	0.471 (0.044)
IS 2(α + β)	5.4 (0.481)	5.48 (0.392)	5.72 (0.437)	5.52 (0.441)	5.32 (0.453)	5.12 (0.491)	4.92 (0.471)	5.12 (0.488)	5.24 (0.466)	5.28 (0.482)
IS (% of Price)	0.371 (0.019)	0.323 (0.021)	0.333 (0.011)	0.352 (0.018)	0.364 (0.014)	0.328 (0.017)	0.366 (0.016)	0.349 (0.018)	0.347 (0.019)	0.352 (0.016)

Quartile 3

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15
α	1.14 (0.623)	1.12 (0.652)	0.98 (0.638)	0.91 (0.572)	0.94 (0.435)	0.72 (0.681)	0.83 (0.618)	1.01 (0.667)	1.09 (p.715)	1.01 (0.628)
β	0.81 (0.278)	0.78 (0.293)	0.76 (0.292)	0.75 (0.284)	0.68 (0.274)	0.66 (0.238)	0.71 (0.198)	0.72 (0.194)	0.84 (0.182)	0.83 (0.238)
α (% of price)	0.72 (0.018)	0.89 (0.043)	0.78 (0.019)	0.075 (0.024)	0.77 (0.029)	0.089 (0.018)	0.091 (0.011)	0.091 (0.017)	0.089 (0.019)	0.071 (0.024)
β (% of price)	0.069 (0.010)	0.03 (0.008)	0.063 (0.009)	0.068 (0.017)	0.072 (0.018)	0.074 (0.018)	0.085 (0.021)	0.072 (0.018)	0.076 (0.019)	0.074 (0.014)
ρ	0.342 (0.028)	0.377 (0.026)	0.343 (0.021)	0.285 (0.019)	0.256 (0.017)	0.270 (0.018)	0.275 (0.076)	0.259 (0.024)	0.315 (0.027)	0.352 (0.031)
γ	0.498 (0.034)	0.475 (0.038)	0.464 (0.043)	0.493 (0.040)	0.468 (0.038)	0.491 (0.037)	0.496 (0.029)	0.418 (0.028)	0.487 (0.034)	0.521 (0.033)
IS 2(α + β)	3.9 (1.254)	3.8 (1.225)	3.48 (2.728)	3.32 (2.118)	3.24 (2.176)	2.76 (2.154)	3.08 (2.132)	3.46 (2.113)	3.86 (1.98)	3.86 (1.92)
IS (% of Price)	0.381 (0.019)	0.344 (0.011)	0.359 (0.018)	0.348 (0.011)	0.325 (0.018)	0.368 (0.020)	0.364 (0.021)	0.366 (0.024)	0.364 (0.028)	0.371 (0.028)

Quartile 4

Particulars	10-10.30	10.30-11	11-11.30	11.30-12	12-12.30	12.30-13	13-13.30	13.30-14	14-14.30	14.30-15
α	0.692 (0.106)	0.701 (0.038)	0.684 (0.087)	0.668 (0.026)	0.603 (0.012)	0.682 (0.018)	0.672 (0.014)	0.694 (0.009)	0.710 (0.012)	0.702 (0.010)
β	0.452 (0.721)	0.486 (0.684)	0.389 (0.672)	0.378 (0.689)	0.428 (0.691)	0.423 (0.663)	0.486 (0.698)	0.472 (0.647)	0.469 (0.648)	0.423 (0.672)
α (% of price)	0.076 (0.004)	0.074 (0.008)	0.068 (0.008)	0.067 (0.007)	0.054 (0.068)	0.083 (0.009)	0.087 (0.005)	0.084 (0.018)	0.081 (0.007)	0.083 (0.0018)
β (% of price)	0.042 (0.002)	0.040 (0.003)	0.048 (0.002)	0.047 (0.003)	0.050 (0.004)	0.049 (0.004)	0.061 (0.008)	0.056 (0.007)	0.057 (0.004)	0.054 (0.007)
ρ	0.354 (0.005)	0.338 (0.005)	0.357 (0.008)	0.366 (0.007)	0.372 (0.006)	0.342 (0.005)	0.348 (0.004)	0.354 (0.004)	0.356 (0.005)	0.371 (0.003)
γ	0.491 (0.015)	0.476 (0.018)	0.474 (0.017)	0.464 (0.029)	0.475 (0.017)	0.469 (0.018)	0.443 (0.017)	0.475 (0.016)	0.438 (0.009)	0.469 (0.008)

IS $2(\alpha + \beta)$	2.28	2.37	2.31	2.33	2.06	2.22	2.31	2.33	2.45	2.25
	(3.416)	(3.59)	3.63)	(3.54)	(3.65)	(3.83)	(3.72)	(3.68)	(3.54)	(3.51)
IS (% of Price)	0.412	0.431	0.425	0.428	0.422	0.423	0.425	0.438	0.446	0.428
	(0.017)	(0.041)	(0.038)	(0.036)	(0.039)	(0.040)	(0.039)	(0.038)	(0.038)	(0.036)

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