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Two Essays in Finance

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TWO ESSAYS IN FINANCE

by

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DEDICATION

This dissertation is dedicated to my mother

Mrs. Somluck Likitapiwat

who gives me all of her endless unconditional love and dedication.

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my major professors, Prof. Christine X. Jiang and Prof. Pankaj K. Jain for their guidance, patience, kindness and support in completing this dissertation. I really appreciate their time and effort spent with me to give advice. I would like to thank Prof. Thomas H. McInish and Prof. Rose M. Rubin for their initiative insights and recommendations on the research. I also wish to thank Prof. C. S. Pyun for his encouragement during my years at the University of Memphis. I would like to thank friends in the Ph.D. program who help and take care of each other to achieve our goals together. Special thanks to Dr. James Upson for his help, guidance and SAS class.

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ABSTRACT

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The dissertation consists of two essays. The first essay examines the information contents of after-hours earnings announcements. The study investigates the after-hours trading (AHT) activities, price contribution and price discovery following the quarterly earnings announcements released outside of the normal trading hours. We hypothesize that trading activity and price discovery on the announcement days are higher than non-announcement days during the same AHT periods. Similarly, the price discovery on earnings announcement days is expected to be higher than that of the non-announcements days during the same AHT periods. For a sample of S&P500 stocks from 2004-2008, we find that despite lower volume, trading activities after hours are heightened on days with earnings announcements. A significant portion of price change and price discovery occurs immediately after the earnings releases during the before market open or after market close sessions. Prices in AHT show relatively large degree of informational efficiency, further demonstrating the importance of the price discovery in AHT as these prices are not likely to be all driven by noise trading.

The second essay is related to the impact of low cost carriers (LCCs) announcement on the legacy airlines. The successful emergence of low cost carriers (LCCs) is an important structural and financial development in the airline industry. Oligopoly structure, entry barriers, and high fixed costs make the industry highly susceptible to competitive and network expansion impacts of LCC entry. We hypothesize that LCC entry not only increases competition in the industry but also expands the number of airline travellers. As a result, the level of competition should have a negative effect on the returns of legacy airlines while network expansion should have a positive effect. We conduct event studies and regression analysis to explore the impacts of LCC entry on legacy airline stock prices. As a surprising result, positive stock returns are observed, which we interpret as the spillover effects of network expansion. Thus, economies of scope from increased passengers and connectivity increase the revenues of legacy airlines to sufficiently offset the LCC competitive threats.

PREFACE

My dissertation consists of two essays and both involve primarily corporate events. I think it is a good idea to discuss briefly of the origin of my essays. The first essay is about the information contents from corporate earnings announcements. Why are most firms making earnings announcements when market is closed? I was fortunate enough to meet Dr. Christine Jiang one day and she suggested to me that I explore this topic. The topic of after-hours earnings announcements has only been pursued by a limited number of research papers, and it is the aim of this paper to fill the academic gap. Therefore, I believe this research idea will be interesting and worth exploring since trading in stock markets is progressing towards a 24-hour market. The details of the analysis are presented in essay 1. It has been submitted to The Journal of Accounting Research.

My second essay examines the effect of low cost airlines company announcements and new market entry on the more established legacy airlines. The motivation for this paper was generated during a finance seminar with Dr. Pankaj Jain. He introduced me to Dr. Rose Rubin who was researching low cost airlines. I had heard of the term low cost airline before but did not know more than the fact that its ticket price is cheaper than the traditional ones. I found that the interactions between players in the industry were not only from the competition but also from network expansion. Detailed analysis of the effects of low cost airlines on the legacy airlines and network expansion effects and stock returns of the legacy airlines are presented in essay 2. This paper has been submitted to The Journal of Industrial Economics.

The assistance I received from Dr. Christine Jiang, Dr. Pankaj Jain, Dr. Thomas McInish and Dr. Rose Rubin during this project was invaluable and has provided me with the skills and techniques necessary to pursue future research opportunities. Without their guidance, it is not possible for me to learn such research skills on my own.

TABLE OF CONTENTS

LIST OF TABLES

Essay 1

Essay 2

LIST OF FIGURES

Essay 1

Essay 2

INTRODUCTION

Corporate events play significant roles in financial markets. There are various kinds of announcements including earnings announcements of public companies, announcements of newly launched products or markets entry, and so on. Information from an announcement of a corporation could have multiple impacts on several market participants, such as investors, competitors, and regulators. Investors use information derived from earnings announcements to help make investment decisions while competitors can use this information to learn about their position in the market and to devise competing strategies. Regulators make use of the information to keep pace with changes in the market to protect investors. We examine the impact of corporate event announcement from two different perspectives. The first chapter is a study of the information contents from the after-hours earnings announcements. The second chapter examines impacts of low cost carriers' (LCCs) entry announcements on the legacy airlines.

In chapter 1, we study the information contents following corporate earnings announcements that are made during market close. Firms have increasingly made their quarterly earnings announcements outside the regular market hours. Normally, trading volumes of the aftermarket are very low compared to trading volume during the normal market hours. Previous research finds that the after-hours periods have lower liquidity, thin trading volume, higher trading cost and higher price volatility. While all types of investors, regardless of large or small, and institutional or retail, can now trade in either regular or after-hours trading sessions. However, stock trading activities still concentrate in the regular trading hours. We aim to fill the gap in previous literatures on market responses in the regular trading hours to earnings announcements made during trading and non-trading hours. We hypothesize that the trading activities during the after-hours periods are heightened on the earnings announcement days compared to the non-announcement days. We also hypothesize that the significant amount of price contribution and price discovery immediately occur after the announcements.

In chapter 2, we examine the impact of announcements and actual entry of LCCs on the legacy airlines in term of competition, network expansion and stock valuation. LCCs have successfully emerged since 1978 and now represent one third of the market. An entry of LCC is typically perceived as a competitor to the legacy airlines. Many papers have investigated the impact of LCCs' entry on the legacy airlines such as airfare reduction and losses in market share. However, no study has been done on network expansion benefits of low cost airlines for the legacy airlines. In this chapter, we investigate the stock price reaction of the legacy airlines when an LCC make an announcement to enter a new market. We hypothesize two opposing effects of LCC entry. First LCC entry increases the level of competition in the overall airline industry and has negative effect on stock return of legacy airlines. Second, the LCC entry creates the network expansion benefit to the legacy airline and has positive effect on stock return of legacy airlines. We test these hypotheses using both entry announcement and actual entry dates.

ESSAY 1

Information Content of Earnings Announcements:

Evidence from After Hours Trading

1. Introduction

After-hours trading (AHT) refers to the buying and selling of securities listed on major exchanges outside of specified regular trading hours (RTH), which in the U.S. are 9:30-16:00. Currently, all types of investors both large and small, and institutional and retail, can trade in one of the two AHT sessions—before market open. However, the belief of proponents of after-hours trading that it would lead to 24-hour trading similar to that in the Forex market has not been realized.[1] In fact, AHT on the NYSE and NASDAQ accounts for only 3 percent of daily trading volume.[2] However, volume in after hours trading tends to be event driven. Overnight news or world market sell-offs drive the early session, and earnings reports drive the after-markets [Mehta, 2009]. After the London subway attack in July 2005, 120 million shares traded in Arca's pre-open session. Similarly, when Google posted a profit that missed Wall Street targets on January 31, 2006 for the first time, its shares went down as much as 19 percent ($70) in AHT, a $15 billion drop in market.

Obviously, understanding AHT on event days, particularly on corporate earnings announcement days, is important for investors and regulators. Several papers study liquidity and price discovery during AHT. Barclay and Hendershott [2003, 2004] report

[1] Matt Krantz, USA Today, May 3, 2007, Investors spurn after-hours trading.

[2] Special Study: Electronic Communication Networks and After-Hours Trading, June 2000. Website http://www.sec.gov/news/studies/ecnafter.htm#pt3i

lower liquidity and thin trading volume in both before market open (BMO) and after market close (AMC) sessions. Moreover, trades in the AMC session make smaller contribution to price discovery than do trades during the BMO. Though they do not study earnings announcements, these authors conjecture that earnings announcements made after the close are likely to be associated with higher volatility and price reversals. We directly test these conjectures.

This topic is timely because firms have increasingly been reporting earnings outside of RTH. Bagnoli, Clement, and Watts [2006] report that only 27% of quarterly earnings announcements occur during RTH. We believe that we are the first to study AHT in reaction to earnings announcements made after-hours. Our study differs from previous studies on trading over a 24-hour period (including after hours, without conditioning on any events) such as Barclay and Hendershott [2003, 2004], and studies on market responses during RTH to announcements made during trading and non-trading hours (Greene and Watts [1996]). In contrast, our primary focus is to examine the immediate reaction of liquidity and price discovery in the AHT session upon the release of earnings news made after hours. Having the ability to trade in AHT allows investors to react quickly to breaking news stories or fresh information. This flexibility in trading is even more valuable when huge price swings and heavy trading are observed when a firm either beats the street's estimates or disappoints.

We collect every earnings announcement for every firm in the S&P 500 for 2004-2008. More than 95% of the announcements are made outside RTH. We address five aspects of trading following after-hours earnings announcements. First, we present fresh evidence concerning the AHT volume, number of trades, and trade size. Our results show that trading increases markedly following announcements. Therefore, we must look beyond the very low volume that typifies AHT trading and, instead, look at event days. Second, we examine the liquidity as measured by the quoted and effective spread. Similar to Barclay and Hendershott [2004], spreads are typically higher during AHT when compared with spreads during regular trading. However, following earnings announcements spreads in AHT are often significantly lower than those on non-announcement days. Third, we study how much of the daily price changes occur in the AHT rather than during RTH. Following Barclay and Warner [1993], we calculate the weighted price changes to measure price contribution from each trading period. We find that the contributions of the BMO and AMC periods are about 36% and 60% of the price changes, respectively. As the length of the times periods differs across BMO and AMC, we further examine the price contribution per trade. We find that price change per trade is higher in the BMO than in the AMC, consistent with Barclay and Hendershott [2003]. We use regression analysis to explore several characteristics of the stocks that may affect price changes. We find that stocks with higher intraday volume and AMC announcements have higher weighted price changes, while price changes are lower for large cap stock and stocks listed on NYSE.

Fourth, we investigate the magnitude of public and private information in the AHT session. We use Hasbrouck's [1991] variance decomposition model to calculate price discovery or trade informativeness. We hypothesize that price discovery on earnings announcement days is higher than that of the non-announcements days during the same AHT periods. We find a significant portion of price discovery during both BMO and AMC sessions on announcement days, 30% and 37% for BMO and AMC announcements, respectively. Also, we use OLS to explore factors that potentially affect the magnitude of price discovery in AHT. We consider a set of explanatory variables that have been used in the previous literature to explain the magnitude of the price discovery. We find that the magnitude of price discovery is positively correlated with trading volume and AMC announcements. Price discovery is lower for large stocks, stocks with higher trading cost, and stocks listed on the NYSE. We find that earnings surprises and analysts followings do not play an important role in price discovery during AHT.

Fifth, we examine the efficiency of AHT prices, using the methodology of Biais, Hillion, and Spatt [1999]. An efficient price indicates the convergence of prices toward equilibrium market valuation. We find that prices in after-hours trading show a relatively large degree of informational efficiency, which further demonstrates the importance of price discovery in AHT as these prices are not likely to be all driven by noise trading.

Our study contributes to the literature in several ways. The findings may be useful for traders, market makers in making decisions on AHT as we shed light on liquidity and price discovery process. Regulators may find our results of interests in deciding whether investors need greater protection during AHT. The regulatory structure, particularly in the areas of investor protection and market integrity, needs to be current and forceful. Our study also contributes to a broad and extensive literature on the post-earnings announcement drift (PEAD) (Foster, Olsen, and Shevlin [1984]) as we examine the immediate reaction to earnings releases. A recent paper by Berkman and Truong [2009] highlights the importance of accounting for after-hours announcements for event studies around earnings announcements. Future studies of market reaction on earnings announcements need to incorporate trading and price discovery in the AHT, a period often ignored in prior literature on PEAD.

2. Literature Review

Barclay and Hendershott [2003] examine the price discovery and trading of NASDAQ securities for the BMO, AMC and RTH. They find that during the BMO and AMC, trading volume is very thin while trading costs and information asymmetry are very high, and that there is a higher frequency of informed trading and more price discovery per trade for the BMO compared to the AMC. In Barclay and Hendershott [2004], the cost of trading measured by effective and realized spreads is larger during BMO and AMC than during RTH. McInish, Van Ness and Van Ness [2002] study the AHT of NYSE-listed stocks on regional exchanges. They find that most active stocks during RTH tend to continue trading actively in AHT. Trading costs are greater in AHT than during regular hours, trading volumes and depths are also lower in AHT. Cao, Ghysels and Hathaway [2000] study preopening quotes as signaling for price discovery on the NASDAQ. They find price contribution per unit time of the locked and crossed periods is larger during the regular trading period.

However, we know of no study of AHT following earnings announcements made outside of RTH. Previous studies focus on AHT in reaction to news during RTH or RTH trading subsequent to announcements made after hours. Our research design allows us to study the immediate market reactions in AHT, which has become increasingly active in recent years. Francis, Pagach and Stephan [1992] investigate the market responses to overnight and daytime announcements of U.S. firms. They focus on volume and price reaction at the open following overnight announcements. Greene and Watts [1996] examine price discovery that occurs during RTH following earnings announcements made both during and outside RTH. Using average transaction returns for 15-minute intervals, they find that the majority of price responses in AHT occur within the first 15 minutes of the next day's trading. However, NASDAQ stocks show a faster price response to earnings announcements during RTH while price adjustment of NYSE stocks is spread over several transactions. Berkman and Truong [2009] point out that event studies of earnings announcements typically assign the Compustat or I/B/E/S earnings announcement date as event day 0, which is incorrect when announcements are made after hours. To accurately measure price changes and abnormal volume in reaction to the after-hours earnings announcements, the event day needs to be adjusted to account for abnormal return and volume occurring in the after-hours periods.

3. Background, Data and Sample Formation

In 1986, Instinet launched the crossing system that matched after-hours orders at the market-closing price. AHT has been limited to high net worth investors and institutional investors until 1999. AHT now is accessible to both institutional and retail investors via ECNs.

We obtain intraday trades and quotes for the NYSE, AMEX, and NASDAQ from TAQ for all firms included in the S&P500 from 2004 to 2008. Following Huang and Stoll [1996], we exclude: trade prices, bid prices, ask prices, trade sizes and quote sizes that are not positive; ask price <= the bid price; locked and crossed quotes; trades that are out of sequence, involve error corrections, or nonstandard settlement (TAQ condition codes

P,W,Z, and G); quotes that are associated with trading halts, order imbalances, or non-firm quotes are excluded (TAQ condition codes 4, 7, 9, 11, 13, 14, 15, 16, 19, 20, and 27);[3] quotes with spreads larger than $5; trade-to-trade and quote-to-quote price change of more than 30%;[4] Our final sample comprises 582 stocks with 10,238 quarterly earnings announcements. 479 of our sample stocks are NYSE-listed and 103 are NASDAQ-listed. We collect daily prices, volumes, market capitalizations, and shares outstanding from the CRSP. We obtain the S&P500 constituents from Compustat Index Constituents.

Our primary source of quarterly earnings announcements is I/B/E/S, which provides both the date and time of earnings releases. We cross check these using data from Compustat and Bloomberg. Compustat reports the firms' earnings release dates, but no release time while Bloomberg only provides the exact time of earnings releases for about 50% of our announcements. We drop announcements made during RTH.

Among the few studies on AHT, different cutoff times are used to identify the AHT sessions: McInish, Van Ness and Van Ness [2002], 9:30-16:00 and 16:00-16:30; Pronk [2006] 9:30–16:00 and 16:00–9:30; Barclay and Hendershott [2003], 8:00–9:30, 16:00–18:30 and 18:30-8:00; Bagnoli, Clement and Watts [2006], 5:00–9:30, 16:00–

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[3] We search TAQ database for trading halts related to earnings announcements; specifically, condition code 4 for news dissemination, and 11 for news pending. There are very few halts related to after-hours earnings announcements. Our sample has a total of 90 halts with condition code 4. No halts with code 11 are found. In addition, halts with condition 7 (order imbalance), which is used in Jiang, McInish, Upson (2009) are also not found. We match the earnings announcement time with the halt time. We find that there are 7 halts during the afternoon periods while the earnings announcements are made in the BMO. The rest are halts in the afternoons associated with the AMC announcements. Out of the 83 AMC halts, 77 halts are issued before the earnings releases and only 6 halts occurred following the earnings releases. On average, we find that trading halts occur 16.42 minutes before earnings announcements and trades resume within 4.30 minutes after the halt.

[4] In their study, Huang and Stoll use 10% to filter data errors during regular trading hours. According to the SEC's special study, trades in the AHT periods tend to have higher volatility and price changes. Therefore, we widen the band to retain more observations.

20:30 and overnight 20:30–5:00. Our classification is very similar to Barclay and Hendershott [2003] and we have the following four periods, 7:00–9:30, 9:30–16:00, 16:00-18:30, and 18:30–7:00.[5]

Table 1 presents the distribution of earnings announcements by time of release. Table 1, Panel A, presents the number of earnings announcements separated by primary exchange. 50% of quarterly earnings announcements are made in the BMO session and 30% in the AMC session. Figure 1 provides a histogram of announcements by 30-minute intervals. Clearly, most of quarterly earnings announcements are made either in BMO or AMC sessions and companies are reluctant to release earning information during RTH. This is consistent with Bagnoli, Clement and Watts [2006] and Berkman and Truong [2009]. Table 1, Panel B, presents the number of announcements by year and shows that the pattern of announcement times has been stable over our five-year sample period.

[5]International markets may be open during the BMO or AMC periods. We examine the operating hours of the 15 largest stocks markets in 2009. Only stock markets in Europe (e.g. London Stock Exchange and Euronext) have few overlapping hours with the BMO and RTH periods while Toronto Stock Exchange is open at the same time as in the U.S. No market is open in the AMC period. As we do not have access in other markets, the cross-market trading is not analyzed here.

TABLE 1

Quarterly Earnings Announcements, by Time of Day and by Year

For NYSE and NASDAQ stocks, we present the distribution of quarterly earnings announcements (n = 10,238) by time of day (Panel A) and by year (Panel B) for the 582 stocks in the S&P500 from January 2004 to December 2008. We report four times periods: before market open (BMO), 7:00 – 9:30; regular trading hours (RTH), 9:30 – 16:00; after market close (AMC), 16:00 – 18:30; and overnight (OVR), 18:30 – 7:00.

Panel A: Number of earnings announcements, by time of day

Time of announcement	NYSE	NASDAQ	Total
7:00 - 9:30 BMO	4,508	461	4,969
9:30 - 16:00 RTH	447	77	524
16:00 - 18:30 AMC	1,909	1,137	3,046
18:30 - 7:00 OVR	1,548	151	1,699
Total	8,412	1,826	10,238

Panel B: Announcements, by time of day

	NYSE					NASDAQ				
Year	BMO	RTH	AMC	OVR	Total	BMO	RTH	AMC	OVR	Total
Number										
2004	835	154	353	284	1,626	77	26	225	37	365
2005	887	107	352	315	1,661	93	15	225	40	373
2006	918	76	407	302	1,703	103	13	220	23	359
2007	933	60	397	322	1,712	105	14	217	24	360
2008	935	50	400	325	1,710	83	9	250	27	369
Percentage										
2004	51.4	9.5	21.7	17.5	100.0	21.1	7.1	61.6	10.1	100.0
2005	53.4	6.4	21.2	19.0	100.0	24.9	4.0	60.3	10.7	100.0
2006	53.9	4.5	23.9	17.7	100.0	28.7	3.6	61.3	6.4	100.0
2007	54.5	3.5	23.2	18.8	100.0	29.2	3.9	60.3	6.7	100.0
2008	54.7	2.9	23.4	19.0	100.0	22.5	2.4	67.8	7.3	100.0

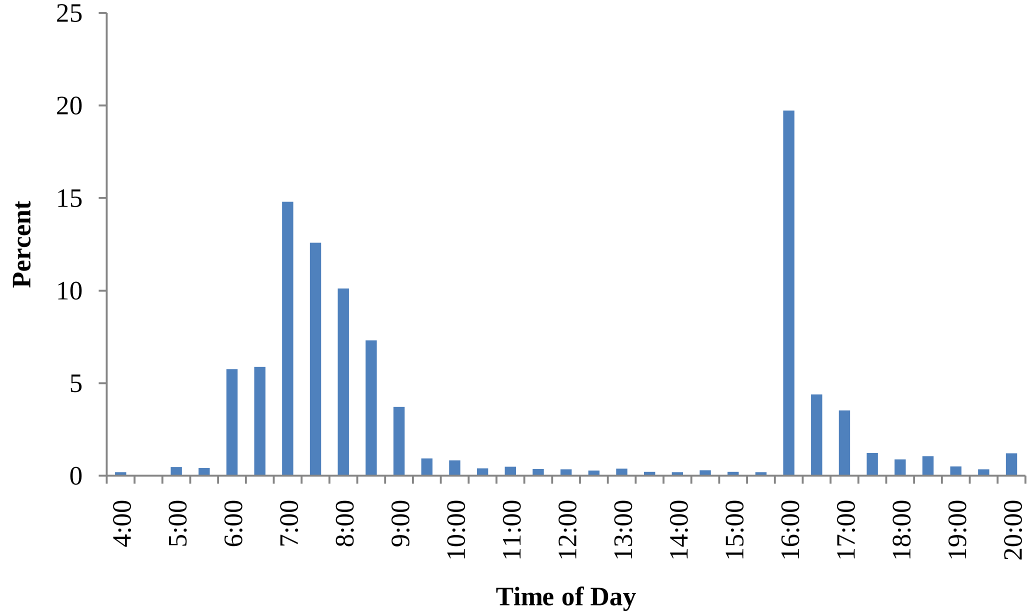


FIG. 1.—Earnings announcements, by time of day. For each 30-minute interval from 4:00 to 20:00 for the years 2004-2008, we present the percentage of earnings announcements for S&P 500 stocks.

Table 2 presents descriptive statistics separately for announcement days and non-announcement days and for various trading sessions. In Table 2, Panel A, we compare and contrast BMO, AMC, and RTH. The announcement day is the day that the quarterly earnings announcement is made, and the non-announcement days are the 10 days prior to and the 10 days following the announcement day.[6]

The number of trades and quotes are counted for each period.[7] Quoted spread is the time weighted average of the difference of the outstanding quotes. Effective spread is two times the volume weighted average of the absolute difference between the trade price and the prevailing quote midpoint. Relative quoted spread is the quoted spread divided by quote midpoint and relative effective spread is the effective spread divided by trade price. Total volume is the number of shares in millions traded in each period and dollar volume is the number of shares in millions multiplied by trade price. Trade size is the average number of shares per trade and market capitalization is the average daily price times the number of shares outstanding.

Results reported in Table 2, Panel A, show that trading activities on announcement days are more intense across all periods compared to those on non-announcement days. Not surprisingly, the RTH session has a much larger number of trades and quotes than the AMC and BMO sessions, regardless of whether there is an announcement. However, for both BMO and AMC sessions, we observe more active trading on announcement days.

[6] We do not include annual announcements in our sample as they typically fall on the same day as the last quarterly announcement of the year.

[7] Since our focus is on BMO and AMC, for brevity, we do not report activity overnight because the trading activity is very thin. Trades and quotes before 7:00 and after 18:30 are rarely found in TAQ.

TABLE 2

Descriptive Statistics

We present descriptive statistics for stocks in the S&P500 index from January 2004 to December 2008. The earnings announcement dates and times are from I/B/E/S. We match the stock symbols and earnings announcement days from I/B/E/S with Compustat and Bloomberg. We obtain trade and quote data from TAQ, quarterly earnings announcements from I/B/E/S, S&P500 constituents from Compustat and market capitalization from CRSP. Number of trades and quotes are from TAQ. Quoted spread is the difference between the ask and bid prices, weighted by the time the quote is outstanding. Effective spread is the absolute difference between the trade price and the prevailing quote midpoint, multiplied by two and volume weighted. Relative quoted spread is the quoted spread divided by the quote midpoint and relative effective spread is the effective spread divided by the trade price. Volume is number of shares traded and Dollar Volume is the number of shares traded multiplied by the trade price. Trade size is the average number of shares per trade and market capitalization is the average daily share price times the number of shares outstanding. Panel A presents statistics for before market open (BMO), 7:00–9:30; regular trading hour (RTH), 9:30–16:00; and after market close (AMC), 16:00–18:30 on the announcement and non-announcement days. The announcement day is the day that quarterly earnings announcement is made, and the non-announcement days are 10 days prior to and 10 days following the announcement day. Panel B and C report statistics for quartiles ranked by dollar volume for BMO and AMC on announcement days.

TABLE 2 – *Continued*

Panel A: Descriptive Statistics on Announcement Days and Non-Announcement Days for Various Periods.

		Number of		Spread				Volume*	Dollar	Trade
Periods		Trades	Quotes	Quoted†	Effective†	Relative††	Rel.Eff.††		Volume**	Size
BMO	Announcement	159	592	136.30	39.09	3.95	1.15	133	3,878	2,716
	Non-Announcement	44	267	169.57	60.27	4.75	1.59	55	1,807	9,255
AMC	Announcement	563	1,597	115.85	32.13	3.17	0.89	512	17,698	11,592
	Non-Announcement	20	194	121.95	34.24	3.34	0.94	219	8,078	15,580
RTH	Announcement	16,677	109,913	11.43	5.20	0.29	0.14	7,230	249,683	546
	Non-Announcement	10,544	83,382	14.16	7.48	0.35	0.19	3,985	137,763	452

Panel B: Descriptive Statistics on Announcement Days for BMO for Quartiles ranked by Dollar Volume

Quartile	Number of		Spread				Volume*	Dollar	Trade
	Trades	Quotes	Quoted†	Effective†	Relative††	Rel.Eff.††		Volume**	Size
1	6	98	180.36	43.47	5.44	1.46	2	63	500
2	28	280	149.02	41.96	4.74	1.32	16	352	1,537
3	75	364	125.07	39.99	3.35	1.04	47	1,603	2,298
4	526	1,629	90.86	30.94	2.28	0.78	468	13,512	6,532

Panel C: Descriptive Statistics on Announcement Days for AMC Quartiles ranked by Dollar Volume

Quartile	Number of		Spread				Volume*	Dollar	Trade
	Trades	Quotes	Quoted†	Effective†	Relative††	Rel.Eff.††		Volume**	Size
1	17	122	121.49	29.55	4.38	1.06	62	1,558	6,315
2	29	187	134.04	33.43	3.28	0.89	104	3,702	9,552
3	71	305	134.74	34.85	3.38	0.82	235	7,364	13,872
4	2,133	5,762	73.15	30.65	1.67	0.79	1,645	58,050	16,551

†cents
††%
*million shares
**million dollars

Quoted spread and relative spread are proxies for trading costs. We find that trading costs are higher in the BMO and AMC compared with those in RTH. As reported by Barclay and Hendershott [2004], the effective spread and realized spread are much larger in the AHT than in RTH. However, when we compare the spreads on announcement and non-announcement days, we find that quoted spread and effective spread are smaller on the announcement days. The relative spread and relative effective spread that are the respective spreads scaled by price are also smaller on the announcement days.

Consistent with the intuition, trading volume on announcement days is higher than on non-announcement days. Investors clearly react immediately to the arrival of new information. Also, the average trade size in AMC and BMO on announcement days is smaller than on the non-announcement days. This is consistent with the stealth trading hypothesis of Barclay and Warner [1993]. Despite the fact that the earning release is public information, informed traders still want to strategically fragmenting their orders to minimize the price impact.

Statistics for quartiles ranked by dollar volume are reported in Table 2, Panels B and C. Stocks in the thickest quartile show significantly more active trading than stocks in the lower quartiles. We also scale the quoted spread and effect spread by stock price and find that spreads are lower for more actively traded stocks.

Figure 2 presents trading volume by minute over the entire trading day. We aggregate the trading volume for each 30-minute interval for each stock and report average volume for announcement days and non-announcement days. We observe that trading volume on the announcement days is consistently higher during the entire day.

We see the spikes of volume in the morning and afternoon for both groups. Figure 2 shows the familiar U-shape pattern of trading volume reported by McInish and Wood [1990]. Figure 3 displays number of trades and dollar volumes for each 30-minute interval before and after the earnings announcements is made. The first 30 minutes after the announcement is period 0. We report the total number of trades during each 30 minutes. Dollar volume is trading price multiplied by volume. We aggregate the data for each stock in each interval and average across all stocks. In general, before earnings are released to public, investors are reluctant to take positions. Reactions are immediate after the announcements as trades are heavily concentrated in the first 30-minutes after announcements. The patterns for BMO and AMC differ. Figure 3, Panels A and B, present the BMO data. After announcements both number of trades and dollar volume increase dramatically. Trading activity remains heightened as the market open approaches. Figure 3, Panels C and D, the AMC data show a peak during the first 30 minutes after the announcement, with trading intensity declining slowly in subsequent intervals. Both trade count and volume remain higher throughout the AMC.

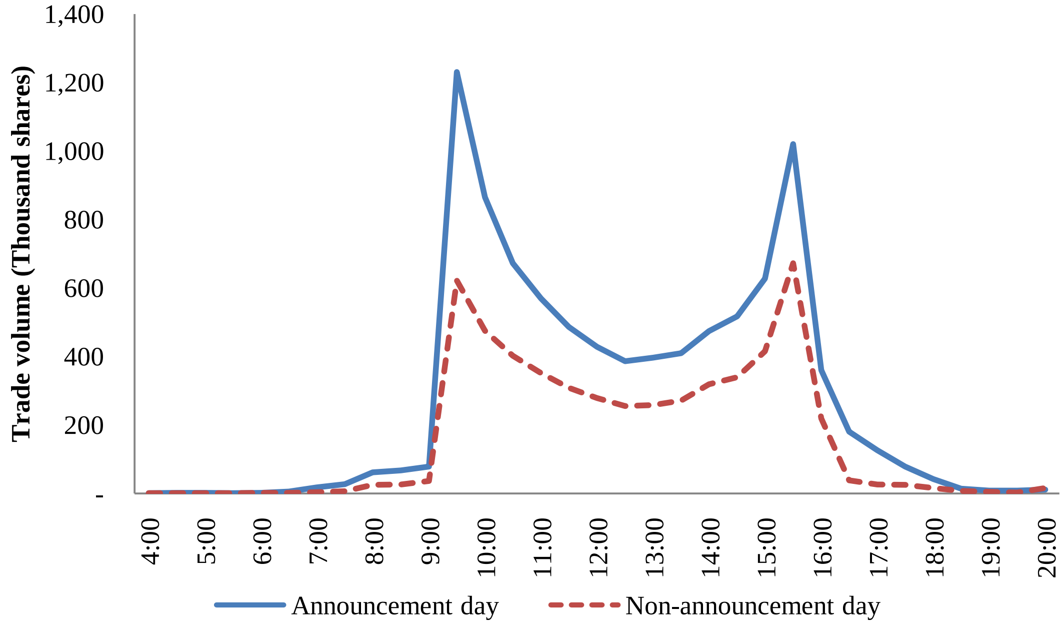
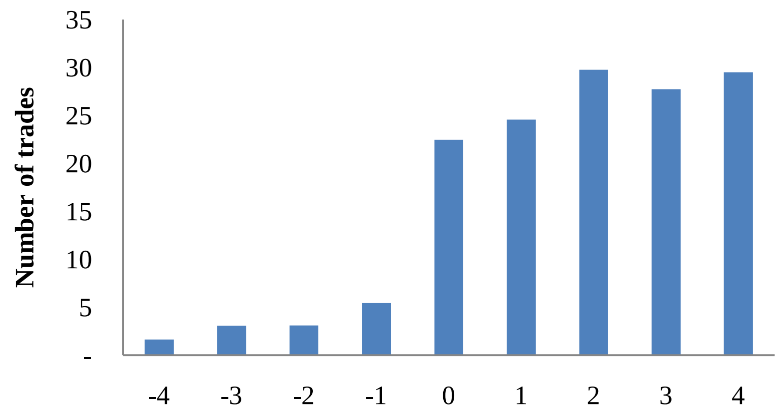
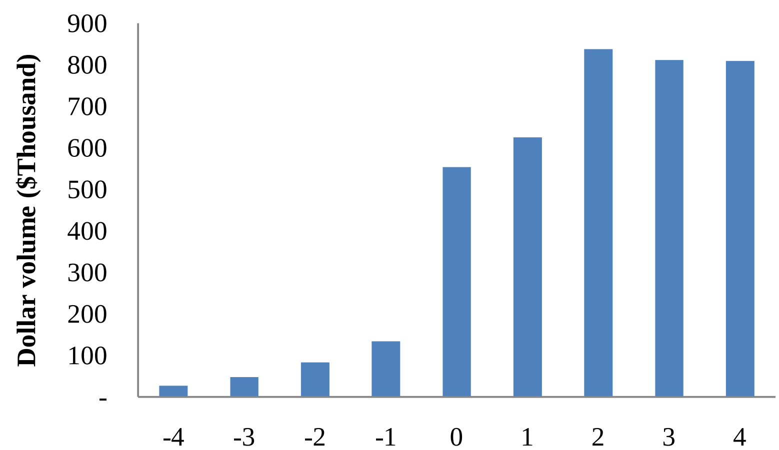


FIG. 2. – Daily trading volume, by time of day. For firms in the S&P500 for the years 2004 to 2008, we plot average daily trading volume for announcement days and non-announcement days by thirty-minute interval from 4:00 to 20:00. Trading volumes are aggregated first by day, then by stock, and then across stocks. We obtain trading data from TAQ and announcement days from I/B/E/S. The non-announcements days are the 10 days before and 10 days after the announcement.

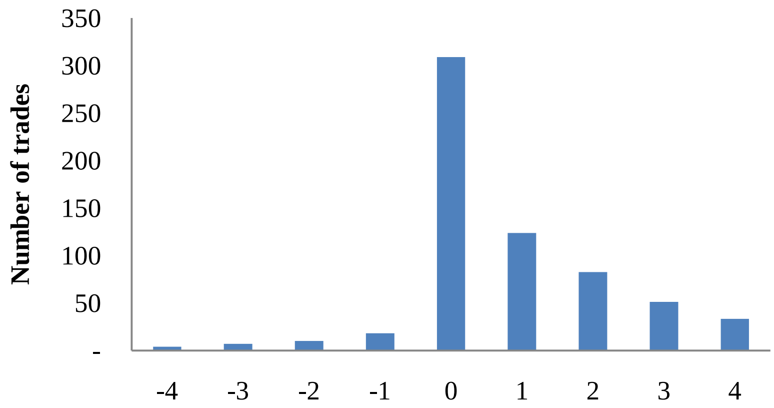


Panel A. Number of trades for BMO sample

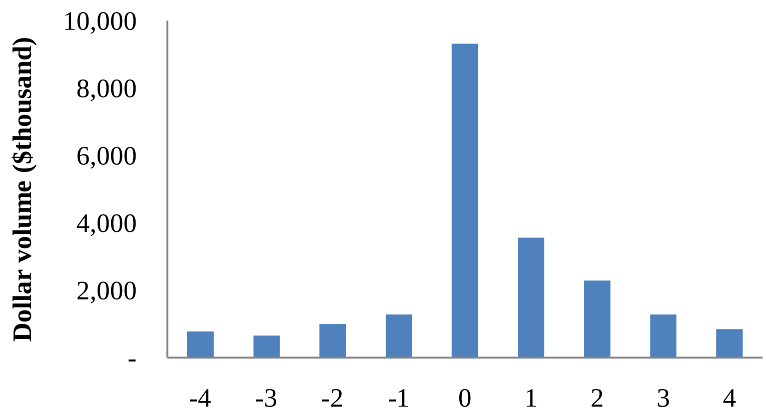


Panel B. Dollar volume for BMO sample

FIG. 3. – Number of trades and dollar volume around the time of earnings announcements. We present the number of trades and dollar volumes for each 30-minute interval around the earnings announcement times for a sample of the firms included in S&P500 from 2004 to 2008. We obtain trading data from TAQ and announcement days from I/B/E/S. We define the first 30 minutes after the announcement time as period 0. The number of trades is counted from the beginning to the end of each interval. The dollar volume is trading price multiplied by volume. We summarize the data for each stock in each interval and average across stocks. Panels A and B demonstrate the number of trades and dollar volumes in thousands for BMO sample while Panels C and D present those of the AMC sample.



Panel C. Number of trades for AMC sample



Panel D. Dollar volume for AMC sample

FIG. 3. – *Continued*

4. Research Methodologies

4.1 WEIGHTED PRICE CONTRIBUTION (WPC*)*

To study the effect of earning announcements on price discovery, we use the weighted price contribution (*WPC*) of Barclay and Warner [1993]. *WPC* computes the fraction of price changes during a given period relative to price changes over a 24-hour period stock return (close-to-close). Barclay and Warner [1993] use the *WPC* to examine price changes associated with trades of different sizes and to identify which trade size moves prices. Cao, Ghysels and Hatheway [2000] use relative time-weighted price contribution (*RTWPC)* to study the contribution of pre-opening to the daily price change and contribution of the crossed and locked period on the NASDAQ. They partition the preopening and trading hours into five periods including pre-cross/lock, lock, cross, post-cross/lock and trading period. The price contribution of each period is scaled by the length of trading time in each period. Barclay and Hendershott [2003] study the price discovery of AHT on 250 stocks with the largest trading volumes on NASDAQ. In sum, *WPC* has been widely used in the literature to measure magnitude of price discovery in different trading periods. Using *WPC*, we can compare the level of price discovery across periods. In addition, weighted price contribution per trade (*WPCT*) can be used to appropriately account for the low amount of trades during market close.

Following Barclay and Hendershott [2003], we compute *WPC* as

$$WPC_i = \sum_{s=1}^{S}\left[\left(|ret_s| / \sum_{s=1}^{S}|ret_s|\right)\cdot\left(ret_{i,s}/ret_s\right)\right] \qquad (1)$$

WPC_i is the weighted price contribution in period i. $ret_{i,s}$ is the log-return during the period i for the stock s.

We calculate *WPC* over a number of periods. The return from announcement to the end of day is the log return from the first trade after the announcement time to the last trade of the day before 18:30. The return for BMO is log return from the first trade that occurs after 7:00 to the opening trade at 9:30. The regular trading day return is the log return of first trade at 9:30 to the last trade at 16:00. ret_s is calculated as the announcement-to-close price of the same day (next day) for BMO (AMC) announcements. *WPC* is calculated for the full sample of all qualified stocks as well as for NYSE and NASDAQ-list stocks.

We also use the *WPCT* calculated as

$$WPCT_i = WPC_i / \sum_{s=1}^{S} \left[\left(|ret_s| / \sum_{s=1}^{S} |ret_s| \right) \cdot \left(nt_{i,s} / nt_s \right) \right] \qquad (2)$$

where $nt_{i,s}$ is the number of trades in each time period i for stock s. For BMO (AMC), we define nt_s as the total number of trades from the announcement time to the close of the same day (next day). Barclay and Hendershott [2003] argue that *WPCT* will be close to one if all trades are equally informative because it is the fraction of the total price change divided by the fraction of trades that occurs in a given time period.

4.2. PRICE DISCOVERY FROM PRIVATE INFORMATION

Hasbrouck [1991a] proposes the vector autoregressive (VAR) model to measure the impact of a trade on price due to asymmetry information and proportion of private information inferred from a trade. The idea of the model is that the market-maker revises his bid and ask quotes following a trade to adjust for information content of trade. Based on the direction of trade, the market-maker adjusts new quotes to reflect the true value of the stock. The VAR model measures how private information is impounded into asset prices through trades. Hasbrouck [1991a] assume the true value of a stock is the midpoint, p_t, which consists of a random-walk component m_t and a stationary component, s_t: $p_t = m_t + s_t$, where $m_t = m_{t-1} + v_t$ and v_t is assumed to be normal distribution with zero mean and constant variance. $E(v_t, v_s) = 0$ for $t \neq s$. The random walk component (m_t) is referred to as the permanent component of the price and the stationary component (s_t) as the transitory component of the price. Variances of the error terms are defined as $VAR(v_{1,t}) = E(\varepsilon^2_{1,t})$ and $VAR(v_{2,t}) = E(\varepsilon^2_{2,t})$. The variance of the permanent price change can be decomposed into price change caused by the arrival of public information and by private information. The VAR model is

$$r_t = \sum_{i=1}^{p} a_i r_{t-i} + \sum_{i=0}^{p} b_i x_{t-i} + v_{1,t} \tag{3a}$$

$$x_t = \sum_{i=1}^{p} c_i r_{t-i} + \sum_{i=1}^{p} d_i x_{t-i} + v_{2,t} \tag{3b}$$

where *a*'s, *b*'s, *c*'s and *d*'s are coefficients of lagged terms of quote returns and trade directions, and $v_{1,t}$ and $v_{2,t}$ are the disturbance. x_t is direction of trade (+1 for buy and -1 for sell order) and r_t is the log return of quote midpoint change following a trade. Note that the contemporaneous value of x_t is included in equation (3a) as the revision of the quote follows the trade but not vice versa. The VAR model can be inverted into vector moving average (VMA) representation as shown in Hasbrouck [1991b][8]. The coefficients of the lag polynomials in the VMA representation are the impulse response functions implied by the VAR. The proportion of private information from trades can be obtained from the variance decomposition method. Under the assumption of invertability, a linear

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[8] We thank Joel Hasbrouck for providing SAS code on his website.

function of quotes return and trades can be expressed in VMA representation. The VMA coefficients are calculated by inverting VAR model to

$$r_t = (v_{1,t} + \sum_{i=1}^{\infty} a_i^* v_{1,t-i}) + \sum_{i=0}^{\infty} b_i^* v_{2,t-i} \tag{4a}$$

$$x_t = \sum_{i=1}^{\infty} c_i^* v_{1,t-i} + (v_{2,t} + \sum_{i=1}^{\infty} d_i^* v_{2,t-i}) \tag{4a}$$

Following Hasbrouck [1991b], we decompose the variance of the random-walk component of the quote changes into the change caused by the arrival of public information and private information from the following equation.

$$\sigma_w^2 = (\sum_{i=0}^{\infty} a_i)^2 \sigma_{v1}^2 + (\sum_{i=0}^{\infty} b_i)^2 \sigma_{v2}^2 \tag{5}$$

The value of $(\sum_{i=0}^{\infty} b_i)^2$ represents the component of price discovery from private information revealed through trades. Variance decomposition technique is applied to data of BMO and AMC announcements. In theory, the lagged terms can be of infinite order but in empirical test, the lagged terms are truncated. Barclay and Hendershott [2003] estimate the VAR system using 10 lag terms and VMA using 20 lags and we do likewise.

To estimate the model, we require our sample stocks to have a minimum of 50 trades and quotes from the announcement time to 9:30 for BMO and from the announcement time to 18:30 for AMC on the announcement days. Following Hasbrouck [1991b], we use the last quote if there is more than one quote with the same time stamp. Trades with the same time stamp and same price are combined into one transaction. If a quote update occurs within 5 seconds following a trade, it is assigned the same time subscript t. We use the prevailing quote midpoint outstanding prior to the trade arrival. If the trade price is above (below) the prevailing quote midpoint, it is a buy (sell). We lag trades by 1 second as suggested by Henker and Wang [2006].

5. Empirical Results

5.1. WEIGHTED PRICE CONTRIBUTION (WPC)

Table 3 presents the *WPC* for the BMO and AMC. In Table 3, Panel A, we report the *WPC* for the BMO announcement from the announcement time to market open (9:30) and from the market open (9:30) to the market close (16:00) to demonstrate the overall picture of price change effect from the time of announcement. *WPC* is 36% over the period from the announcement time to the opening price. The larger portion is contributed by the trades during RTH.

In Table 3, Panel B, that for AMC announcements, 56% of the *WPC* is from the announcement time to the opening price the next trading day. Unlike the BMO announcements, investors have more time if the announcement is made in AMC before the next day's RTH. Investors who have access to AHT act upon the news before RTH of the next day.

We also examine NYSE and NASDAQ stocks separately. For BMO announcements, we find that 36%-40% of *WPC* is from the announcement time to the opening price while the larger portion of *WPC* is contributed from RTH trades. For AMC announcements, 47%-64% of *WPC* is from the announcement time to the next day's opening price. The large price change for the AMC announcements is consistent with Cliff, Cooper and Gulen [2008] who document that the return overnight is the primary source of U.S. equity premium with the exception that we condition on the stock prices response when the quarterly earnings are made public

Since the AMC announcement has longer time for investors to react, we examine the *WPC* for three sub-periods in greater detail. Most of price contribution comes immediately after the announcement and by the end of the AMC session 42-51% of price change has occurred. The *WPC* from the overnight return and BMO of the next day are minimal. Trading during the subsequent RTH contributes the remaining *WPC*.

Our results differ from Barclay and Hendershott [2003] who report that the price changes in BMO are larger than AMC and that the largest portion of 24-hour price change (close-to-close) is from the RTH. We believe that these differences can be attributed to the fact that we examine the price change on the earnings announcements days while Barclay and Hendershott [2003] study the overall after-hours periods without conditioning on any informational event. In addition, we focus on the price change due to the earnings announcement; therefore, the total return of the event day (ret_s) is not exactly a close-to-close return, but the price change from the earnings announcement time to the close.

TABLE 3

Weighted Price Contribution (WPC) and Weighted Price Contribution per Trade (WPCT) for BMO and AMC Announcements

We examine the weighted price contribution (WPC) and weighted price contribution per trade (WPCT) for BMO and AMC announcements for S&P500 stocks during 2004 to 2008. BMO announcements occur from 7:00 to 9:30 and AMC announcements occur from 16:00 to 18:30. For BMO announcements, we measure the price contribution from (1) the announcement time to 9:30, and (2) 9:30 to 16:00. For AMC announcements, we measure the price contribution from (1) the announcement time to 18:30, (2) 7:00 to 9:30, and (3) 9:30 to 16:00. The WPC for period i is:

$$WPC_i = \sum_{s=1}^{S}\left[(|ret_s|/\sum_{s=1}^{S}|ret_s|)\cdot(ret_{i,s}/ret_s)\right] \quad (1)$$

Where $ret_{i,s}$ is the log return during period i for the stock s. ret_s is calculated as the announcement-to-close price of t = 0, nt_s is the total number of trades from the announcement time to the close on t = 0 and $nt_{i,s}$ is the number of trades in each time period i for stock s. The WPCT for period i is:

$$WPCT_i = WPC_i/\sum_{s=1}^{S}\left[(|ret_s|/\sum_{s=1}^{S}|ret_s|)\cdot(nt_{i,s}/nt_s)\right] \quad (2)$$

In each case, we present results for the entire sample and for the NYSE and NASDAQ stocks. The WPC results for BMO and AMC announcements are presented in Panels A and B and the WPCT results for BMO and AMC are presented in Panels C and D, respectively.

Panel A: WPC for BMO announcements

	Price contribution period	
	Announcement to 9:30	9:30 to 16:00
Entire Sample	0.36	0.64
NYSE	0.36	0.64
NASDAQ	0.40	0.60

Panel B: WPC for AMC announcements

	Announcement to 18:30	7:00 to 9:30	9:30 to 16:00
Entire sample	0.42	0.14	0.40
NYSE	0.32	0.15	0.47
NASDAQ	0.51	0.13	0.33

(Continued)

TABLE 3 – *Continued*

Panel C. WPCT for BMO announcements

	Price contribution period	
	Announcement to 9:30	9:30 to 16:00
Entire sample	45.05	0.64
NYSE	57.26	0.65
NASDAQ	20.44	0.61

Panel D. WPCT for AMC announcements

	Announcement to 18:30	7:00 to 9:30	9:30 to 16:00
Entire sample	10.11	9.61	0.42
NYSE	20.76	26.82	0.48
NASDAQ	7.68	5.65	0.36

Next, we present the results of *WPCT* for the same sample for the BMO and AMC announcements in Table 3, Panels C and D. Barclay and Hendershott [2003] argue that the value of *WPCT* will be close to one if every trade conveys equal information. We find a similar pattern that *WPCT* of AHT are greater than one across all sample and sub-periods, compared with *WPCT* less than one during RTH. In contrast to the *WPC* results, trading in BMO is more informative than AMC when measured per trade. The *WPCT* of BMO sample is 45 while it is only 10 for the AMC sample. Even though the length of BMO is shorter, trades are more likely from informed traders. Holden and Subramanyam [1992] present a model in which informed investors facing competition want to use their private information as quickly as possible.

Since we find that *WPC* in the AHT sessions are relatively high compared to the RTH for the announcement day, this should not be the case for days without significant informational events such as earnings announcements. To verify this, we compare *WPC* on announcements days and several days before and after the announcement day. We examine whether the *WPC* on event days are significantly different from other days, and report the results in Table 4.

The *WPC* of the announcement day is denoted as day 0. Five days prior to the event are denoted as [-5] to [-1] and five days following the event are [+1] to [+5]. For brevity, we report the results for the announcement day, denoted as [0], one day prior to and following the announcement, denoted as [-1] and [+1], and the average of price discovery for two to five days prior to and following the announcement, denoted as [-2 to -5] and [+2 to +5], respectively. As there are no exact starting and ending times for AHT on the non-announcement days, we calculate the price contribution based on the entire period. Specifically, for the BMO sample, *WPC* is calculated for 7:00-9:30 and 9:30-16:00. For the AMC sample, *WPC* is calculated for 16:00-18:30, 7:00-9:30, and 9:30-16:00. We find that for both BMO and AMC samples, the price contributions in the AHT periods are significantly larger only on announcement days. For the BMO sample, the *WPC* surrounding the announcement days ranges from 16% to 24% while the largest contributions are from the RTH period. Similarly, for the AMC sample, *WPC*s during the AMC periods, and BMO periods of the following day are significantly smaller than that of the announcement day. The *WPC* in the AMC period is from 2% to 8% and BMO period from 1% to 6%. The significance level of price contribution is derived from the RTH. Thus, the results are consistent with our earlier notion that information environments are very different in AHT trading when material information is released after hours.

TABLE 4

Robustness Test of WPC around the Earnings Announcement Days

We estimate the weighted price contribution for the announcement days and 5 days prior and 5 days after. We include only stocks that have sufficient trades to compute WPC in the BMO and AMC sessions during 5 days surrounding the announcement date. For brevity, we present the result for day 0, -1, +1, the average of days -2 to -5 and the average of days +2 to +5. Panel A presents the results for BMO announcement sample and Panel B presents the results for AMC announcement sample.

Panel A: WPC surrounding the BMO announcements

	7:00 to 9:30		9:30 to 16:00	
Day	WPC	t-stat	WPC	t-stat
[-2 to -5]	0.17	20.99**	0.83	-4.11**
[-1]	0.18	17.88**	0.82	-3.16**
[0]	0.36		0.64	
[+1]	0.21	15.25**	0.80	-2.90**
[+2 to +5]	0.21	22.10**	0.79	-2.39*

Panel B: WPC surrounding theAMC announcements

	16:00 to 18:30		7:00 to 9:30		9:30 to 16:00	
Day		t-stat		t-stat		t-stat
[-2 to -5]	0.04	36.29**	0.02	5.78**	0.79	-4.33**
[-1]	0.04	32.02**	0.01	6.44**	0.81	-5.80**
[0]	0.42		0.14		0.40	
[+1]	0.03	45.39**	0.01	6.53**	0.81	-5.11**
[+2 to +5]	0.03	50.21**	0.03	2.89**	0.84	-6.78**

*Significant at the 0.05 level

**Significant at the 0.01 level

5.2. CROSS-SECTIONAL REGRESSION ANALYSIS ON WEIGHTED PRICE CONTRIBUTION

To gain insights on the factors that influence the magnitude of *WPC*, we perform a cross-sectional analysis to examine the relation between *WPC* and several characteristics of the stocks. Foster, Olsen and Shevlin [1984] show that firms with a greater number of analysts following experience higher abnormal price changes. Barclay and Hendershott [2008] regress *WPC* on the fraction of trading activity in the BMO and also on variables such as log market capitalization and daily dollar volume that control for stock characteristics. They report a higher price contribution following unexpectedly high pre-open trading volume. Greene and Watts [1996] report that stocks react differently to earnings announcements made during the different time periods. For the announcements in the non-trading period, price changes occur immediately when the market opens. The adjustment is smoother for the RTH announcements. Similarly, Masulis and Srivakumar [2002] find that NASDAQ stock prices can adjust faster than NYSE/AMEX stocks on the event of seasoned stock offering. Barclay and Hendershott [2003] find that the BMO session has a higher level of price contribution per trade than AMC.

Consistent with the approach in the prior literature, we include the number of analysts, earnings surprises, daily dollar volume and market capitalization in our regression. We include the dummy variables to control for the time of announcements, and primary listing exchanges.

We use *WPC*, the proportion of individual return from earnings announcements to the total price change, as the dependent variable. We estimate the following OLS regression.

$$WPC = \alpha + \beta_1 Analysts + \beta_2 Surprise + \beta_3 Volume + \beta_4 Firm\_Size + \beta_5 AMC + \beta_6 NYSE + \varepsilon \quad (6)$$

where *Analysts* is the number of analysts following a stock reported in I/B/E/S details files for each quarter. *Surprise* is the difference of actual earnings and average analysts forecast for each quarter of each stock divided by the standard deviation of analyst estimates. *Volume* is the average log value of one-month daily trading volume prior to the announcement date. *Firm_Size* is the average log value of market capitalization a month before the announcement day. AMC is a control variable for the announcement period. AMC is 1 for AMC and 0 for BMO. NYSE is a control variable for the primary exchange of the sample stocks. NYSE is 1 for NYSE-listed stocks and 0 for NASDAQ-listed stocks.

The regression results are reported in Table 5. We report four alternative specifications. *Analysts* is significantly positive only in the first model. *Surprise* is not statistically significant across all models. Our findings differ from the results on PEAD phenomenon, which shows that the returns over the longer term are closely related to the direction and the magnitude of the earnings surprises. *Volume* has a strong positive impact on *WPC*. On the contrary *Firm_Size* has a significant negative impact on the *WPC* in AHT. The results are robust across all models. Additionally, we find that *AMC* and *NYSE* also are significant. The dummy for AMC shows a significant positive relation to the *WPC* in both models 2 and 4, indicating that the earnings announcements made in

AMC have higher price changes. The coefficients for primary exchange are negative, indicating that stocks listed on NYSE tend to have lower *WPC*. This is in line with Masulis and Shivakumar [2002] who also report that NYSE stocks have slower price adjustment than those on NASDAQ.

5.3. PRICE DISCOVERY FROM PRIVATE INFORMATION

We examine price discovery based on the methodology proposed in Hasbrouck [1991a, b]. We use trades and quotes of AHT from TAQ database to estimate the fraction of price discovery from private information for AMC and BMO announcements. We only include earnings announcements occurring during AMC and BMO periods. Hasbrouck [1991b] restricts his sample firms to have at least 500 observations in shorter trading periods for intraday analysis.[9] We do the same because AHT is usually very thin compared to the RTH. Many stocks have no trading activity recorded on TAQ before 9:30 and after 16:00. Since the model requires lagged values of trades and quote based returns, we need to have a sufficient number of trades and quotes to obtain meaningful results. We apply a stricter rule to ensure that there are sufficient observations to estimate the model. First, a stock must have at least 50 trades and quotes on the earnings announcement days. In the TAQ database, quotes sometimes occur without any trades or trades without quote during the pre-market or after-close. For comparison purpose, we have to estimate the price discovery for the stocks around announcement days. We therefore impose the second filter that there must be sufficient observations to estimate the results around the announcement day. For non-announcement days, some stocks have

[9] Hasbrouck (1991b, p.589).

no trading activity at all. The wider the window is, the fewer observations we obtain. Therefore, we choose to examine a 5-day window before and after the announcement days.

In Table 6, we present the price discovery results for AHT following earnings announcements. We find that price discovery during the BMO period is 29.9% and AMC is 37.0%. We also report the level of price discovery for groups ranked by dollar trading volume in AHT. We find a positive relationship between trading volume and price discovery. For the BMO announcements, we find a slight increase in price discovery with trading volume from the lowest group at 28.0% to the highest group at 32.5%. For the AMC announcements, we find a stronger relationship as price discovery increases from 34.4% for the lowest trading volume group to 39.2% for the most actively traded group.

Although there seem to be a significant amount of price discovery from private information through AHT on announcement days, we are interested in understanding whether more active price discovery occurs on event days (as opposed to AHT on non-event days). To address this issue, we compare and contrast the price discovery on the event days and non-event days and report the results in Table 7. The price discovery of the announcement day is denoted as day 0. We examine five days prior to the event and five days following the event. For brevity, we report the result for the announcement day, denoted as [0], one day prior to and following the announcement, denoted as [-1] and [+1], and the average of price discovery for two to five days prior to and following the announcement, denoted as [-2 to -5] and [+2 to +5], respectively. Because there are no exact starting and ending times for AHT on the non-announcement days, we use two alternative ways to consider matching the time period with those on announcement days.

TABLE 5

Cross-sectional Analysis of Weighted Price Contribution (WPC)

We report results of the regression of WPC against explanatory variables. The WPC for period *i* is:

$$WPC_i = \sum_{s=1}^{S}\left[(|ret_s|/\sum_{s=1}^{S}|ret_s|)\cdot(ret_{i,s}/ret_s)\right] \qquad (1)$$

Where $ret_{i,s}$ is the log return during period *i* for the stock *s*. ret_s is calculated as the announcement-to-close price of t = 0. The regression is:

$$WPC = \alpha + \beta_1 Analysts + \beta_2 Surprise + \beta_3 Volume + \beta_4 Firm\_Size + \beta_5 AMC + \beta_6 NYSE + \varepsilon \qquad (6)$$

where *Analysts* is the number of analysts following a firm reported in I/B/E/S details files for each quarter. *Surprise* is the difference between actual earnings and average analysts forecast for each quarter for each stock divided by the standard deviation of analyst estimates. *Volume* is the average log value of daily trading volume one month prior to the announcement day. *Firm_Size* is the average log value of market capitalization one month before the announcement day. Two dummy variables are used. AMC is a control variable that equals 1 for AMC and 0 for BMO announcements. NYSE equals 1 for NYSE-listed stocks and 0 for NASDAQ-listed stocks.

Independent Variables	1	2	3	4
Intercept	0.0439	0.0288	0.0486	0.0336
	6.05***	4.01***	6.75***	4.67***
Analysts	0.0003	0.0000	0.0001	-0.0001
	3.39***	-0.15	1.01	-1.08
Surprises	0.0107	0.0085	0.0013	0.0032
	0.67	0.54	0.08	0.20
Volume	0.0043	0.0033	0.0031	0.0027
	9.05***	6.93***	6.34***	5.55***
Firm_Size	-0.0058	-0.0040	-0.0042	-0.0033
	-11.95***	-8.16***	-8.39***	-6.55***
AMC		0.0149		0.0129
		15.56***		12.86***
NYSE			-0.0119	-0.0071
			-10.60***	-6.10***

***Significant at the 0.01 level

First, we estimate the price discovery based on the entire period, that is, trades and quotes from 7:00 to 9:30 for BMO and 16:00 to 18:30 for AMC. Second, we use the time of announcement to the end of the respective AHT trading sessions for the ten-day window surrounding the event. We find similar patterns of price discovery except in a few cases. Hence, we present the results based on the sample using the entire period of the AHT session. We confirm that price discovery is the highest on earnings announcement days. As reported in Table 6, for the BMO announcement, price discovery during the period from announcement time to before market open is about 29.9%. For the AMC, price discovery is 37.0%. The highest percentage of price discovery is also found for NYSE and NASDAQ sub-samples on the announcement days. Other days surrounding the events are noticeably lower. T-statistics and the significance levels of standard paired t-test are presented. The price discovery on the announcement day is significantly different from other days. Figure 4 depicts the price discovery on each day over the 11-day window (the announcement day, 5 days before, and 5 days after). In general, BMO sessions have relatively higher price discovery than the AMC sessions. Except on the announcement day, the price discovery for the AMC session is higher than BMO. This is quite consistent with the fact that overnight news in the world markets and scheduled macroeconomic news releases often drive the early session and provide investors incentives to trade during BMO.

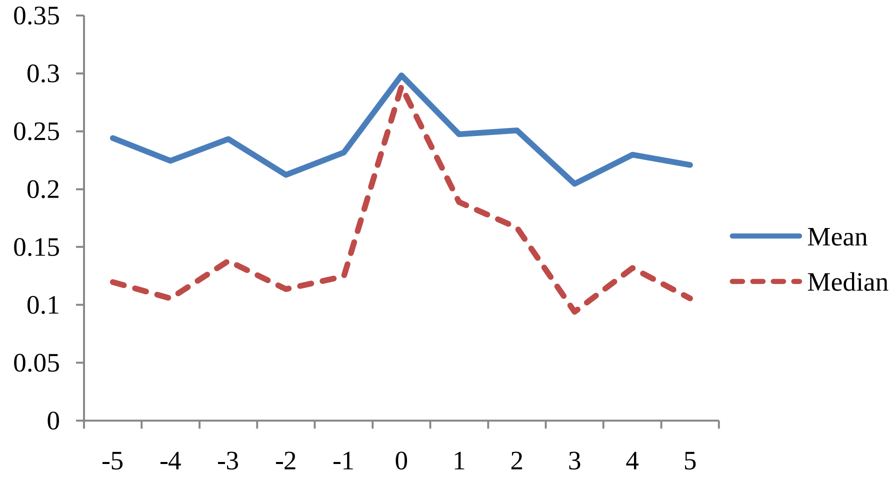
TABLE 6

Price Discovery for BMO and AMC Announcements

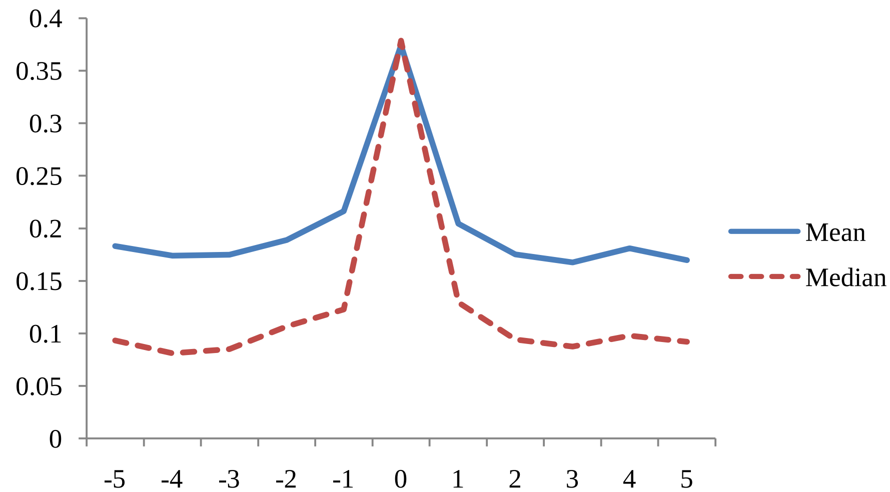
We report the price discovery for earnings announcement of stocks listed in S&P500 during 2004 to 2008. We define price discovery as the proportion of private information to total information. We use method proposed by Hasbrouck [1991a] to measure price discovery. Our model uses quote revisions, the log return of mid-quote change, and signed trades. Trades are lagged for 1 second to match the prevailing quote. Due to lack of trading activity during the after- hours sessions, we restrict the sample stocks to have a minimum of 50 trades and quotes from the announcement time to 9:30 for BMO and from the announcement time to 18:30 for AMC announcements. Following Barclay and Hendershott [2003], we use 20 lags. For the AMC and BMO announcements, in turn, we report results for the overall sample and for quartiles based on after-hours trading volume. F-statistics for testing the null hypothesis of equal means among the four quartiles are provided in italic.

Trading volume quartiles	Announcement	
	BMO	AMC
	Price discovery	
Overall	0.299	0.370
1 (thin)	0.280	0.344
2	0.291	0.356
3	0.299	0.389
4 (thick)	0.325	0.392
F-statistics	2.07**	3.53**

** Significant at the 0.05 level



Panel A. BMO announcements



Panel B. AMC announcements

FIG. 4.–Price discovery around BMO and AMC announcements. We estimate the ratio of private information to total information using the approach of Hasbrouck [1991a, b]. For BMO and AMC announcements, we plot the means and medians of this ratio estimated for the announcement day and for 5-days before and after the earnings announcement.

TABLE 7

Robustness Test of Price Discovery around the Earnings Announcement Days

We estimate the price discovery for the announcement days and 5 days prior and 5 days after. We use the method proposed by Hasbrouck [1991a] to measure price discovery. Our model uses quote revisions, the log return of mid-quote change, and signed trades. Trades are lagged for 1 second to match the prevailing quote. We require sample stocks to have a minimum of 50 trades and quotes from the announcement time to 9:30 (18:30) for BMO (AMC). Following Barclay and Hendershott [2003], we use 20 lags. Panel A presents the results for the overall sample. For brevity, we present the results for day 0, -1, +1, the average of days -2 to -5 and the average of days +2 to +5. Panels B and C present the results for NYSE-listed stocks and NASDAQ-listed stocks, respectively.

Day	BMO	t-stat	AMC	t-stat
Panel A. Overall sample				
[-2 to -5]	0.231	5.56***	0.180	29.79***
[-1]	0.232	4.08***	0.216	16.84***
[0]	0.299		0.370	
[+1]	0.247	3.36***	0.205	19.91***
[+2 to +5]	0.226	6.12***	0.173	31.18***
Panel B. NYSE-listed stocks				
[-2 to -5]	0.255	3.81***	0.225	8.19***
[-1]	0.257	2.58***	0.246	4.45***
[0]	0.313		0.331	
[+1]	0.263	2.45**	0.233	5.83***
[+2 to +5]	0.226	6.12***	0.173	31.18***
Panel C. NASDAQ-listed stocks				
[-2 to -5]	0.202	4.06***	0.166	33.04***
[-1]	0.200	3.22***	0.203	18.22***
[0]	0.28		0.393	
[+1]	0.229	2.28**	0.192	20.90***
[+2 to +5]	0.194	4.59***	0.165	33.45***

**Significant at the 0.05 level

***Significant at the 0.01 level

5.4 CROSS-SECTIONAL REGRESSION ANALYSIS ON PRICE DISCOVERY

Price discovery varies cross sectionally. In this section, we examine the relationship between price discovery subsequent to after-hours earnings announcement and several explanatory variables. Atiase [1985] finds that a firm's size has a negative relation to unexpected earnings. He argues that large firms have more pre-disclosure information available to investors. As a result, reaction to the actual earnings announcements is lower. Shores [1990] uses a firm's size and number of analysts to proxy for interim information and find a negative relation between market reactions and firm's size and number of analysts. Gleason and Lee [2003] report a faster price adjustment subsequent to announcements for stocks that receive greater analyst coverage.

Turning to PEAD, Foster, Olsen and Shevlin [1984] find that the sign and magnitude of unexpected earnings can affect price changes. Obviously earnings surprises play an important role in PEAD when measured over the longer time period (5 days to quarters). However, previous studies do not consider the impact of earnings surprises on price discovery during AHT.

Libby, Mathieu and Robb [2002] find that spreads are relatively wider following earnings announcements on the Toronto Stock Exchange. In contrast, Pronk [2006] finds that spreads are narrower for NYSE and AMEX firms. We include the spread during AHT following earnings announcements to test whether the spread is related to price discovery. Trading volume around the earnings announcement is also important. While McInish, Van Ness and Van Ness [2002] report that actively traded stocks tend to be active in the after-hours, abnormal volume are usually observed on the event day

(Garfinkel and Sokobin [2006]). Thus, we adopt the average daily trading volume to distinguish these effects from the firm's size.

Timing of announcement can make a difference. Prior research shows that stock prices react differently to earnings announcements made during the trading hours and when market is closed (Francis, Pagach and Stephan [1992]). Barclay and Hendershott [2003] find that the BMO session experiences higher level of price discovery than AMC. Lastly, difference in market structure between the NYSE and NASDAQ can also affect price discovery. Greene and Watts [1996] and Masulis and Shivakumar [2002] report that market structure causes the price adjustments on NASDAQ to be different from that on NYSE.

We employ linear regression to examine relationship between the price discovery and explanatory variables. The dependent variable is the price discovery of AHT following earnings announcements. Most of the independent variables are the same as defined in section 5.2.We include an additional determinant, *AHspread*, which is the relative effective spread of the corresponding AHT session on the announcement day.

$$Price\ discovery = \alpha + \beta_1 Analysts + \beta_2 Surprise + \beta_3 Volume + \beta_4 Firm\_Size + \beta_5 AHspread + \beta_6 AMC + \beta_7 NYSE + \varepsilon \quad (7)$$

The OLS regression results reported in Table 8 indicate that *Analysts* and *Surprise* do not play an important role in price discovery in the short run. We find that daily *Volume* and *Firm_Size* are significant determinants of price discovery. The positive relation between *Volume* and price discovery lends support to the previous findings of the abnormal volume on the announcement day. The volume can be from informed traders who possess private information and wish to capitalize on their informational advantage in a timely fashion. *Firm_Size* has a negative relation with price discovery following the earnings announcements in AHT. In addition, we examine the liquidity effect during the AHT on price discovery by using the relative effective spread from the corresponding AHT session. Negative coefficients of after-hours spreads support the notion that market friction lowers the price discovery since spreads are interpreted as trading costs to investors. Higher spread is obviously an indication of friction to investors who wish to trade the stocks in AHT and hinders price discovery process in non-normal trading hours.

We obtain consistent results from AMC and NYSE dummy variables across different regressions. The dummy AMC shows positive and significant coefficients, which indicates that earnings announcements made during AMC are associated with a higher level of price discovery than those made in BMO period. The coefficient for dummy NYSE is significantly negative, meaning that stocks that are listed on NYSE obtain lower price discovery than those listed on NASDAQ.

TABLE 8

Regression Analysis of Price Discovery

We present the results of the regression of price discovery on our independent variables for earnings announcement of stocks listed in S&P500 during 2004 to 2008. We use method proposed by Hasbrouck [1991a] to measure price discovery. Our model uses quote revisions, the log return of mid-quote change, and signed trades. Trades are lagged for 1 second to match the prevailing quote. We estimate the following regression model:

$$\text{Price discovery} = \alpha + \beta_1 Analysts + \beta_2 Surprise + \beta_3 Volume + \beta_4 Firm\_Size + \beta_5 AHspread + \beta_6 AMC + \beta_7 NYSE + \varepsilon \quad (7)$$

where *Analysts* is the number of analysts following a firm reported in I/B/E/S details files for each quarter. *Surprise* is the difference between actual earnings and average analysts forecast for each quarter for each stock divided by the standard deviation of analyst estimates. *Volume* is the average log value of one-month daily trading volume prior to the announcement day. *Firm_Size* is the average log value of one-month market capitalization before the announcement day. *AHspread* is the relative effective spread of the corresponding after-hour period on the announcement day. AMC is a control variable that equals 1 for AMC and 0 for BMO announcements. NYSE equals 1 for NYSE-listed stocks and 0 for NASDAQ-listed stocks. We combine the AMC and BMO announcements. We estimate the model separately for AMC announcements and for BMO announcements. The t-statistics of the coefficients are reported in italic.

Independent Variables	1	2
Intercept	-0.1332	-0.0551
	-1.34	*-0.54*
Analysts	0.0013	0.0012
	1.47	*1.36*
Surprise	-0.0945	-0.0749
	-0.74	*-0.59*
Volume	0.0413	0.0391
	*4.56****	*4.32****
Firm_Size	-0.0215	-0.0232
	*-2.76****	*-2.98****
AHspread		-0.0114
		*-3.13****
AMC	0.0632	0.0679
	*4.57****	*4.90****
NYSE	-0.0521	-0.0475
	*-4.61****	*-4.18****

***Significant at the 0.01 level

5.5 THE EFFICIENCY OF PRICE DISCOVERY AFTER EARNINGS ANNOUNCEMENT

RHT is very different from AHT trading. Lack of liquidity and high trading costs can impede efficient price discovery. AHT costs can be large and create high temporary price impact (Barclay and Hendershott [2003]). Trading prices around earnings announcements moment tend to be noisy due to investors speculation, and heterogeneous interpretation of the information (Garfinkel and Sokobin [2006]). We use the method suggested by Biais, Hillion and Spatt [1999] to estimate the noisiness of stock return and efficiency of price discovery after earnings announcements. As suggested in Barclay and Hendershott [2003], the slope coefficient of the regression can be interpreted as a signal to noise ratio. Since we focus on the earnings announcement events only and the announcement times vary from one company to another, we are not able to segment the regression into intervals to measure price efficiency as in their paper. Instead, we regress the announcement-to-close return on the return from announcement-to-open since our primary event of interest starts at the earnings announcement time. An earnings announcement occurs on day t=0, which begins with the first trade or quote following the most recent market close prior to the announcement and ends with the next market closing price after the announcement. To capture the effect from the announcement, we use the last trade price before the announcement to the opening and close price of the RTH. Specifically, for BMO, the returns are calculated from the last trading price before the announcement to the opening price (r_{ao}), and to the close price (r_{ac}) of the same day. For AMC, the returns are calculated from the last trading price before the announcement to the opening price (r_{ao}), and to the close price (r_{ac}) of the next day.

$$r_{ac} \quad = \alpha + \beta r_{ao} + \varepsilon_i \tag{8}$$

Since our focus is the immediate reaction of return after the announcement, we treat each earnings announcement event as one observation. We estimate the regression for overall sample and separately for BMO and AMC sample. Because the BMO announcement is closer to the RTH, traders have less time to assimilate earnings information compared to the AMC announcements when traders have overnight. In addition, BMO announcements may also occur concurrently on days with economic news. Therefore, it is of interest to investigate whether the efficiency of returns differs for BMO and AMC periods.

Table 9 presents the results of price efficiency of sample. In general, the coefficient is close to one in all cases. The beta coefficient is 0.99 for the full sample. In Table 9, Panels B and C, the BMO subsample has a beta coefficient of 0.978 while the coefficient of AMC is 1.017. None of the alpha coefficients are significantly different from zero. Thus, the price reactions on the earnings announcements are quite efficient. Barclay and Hendershott [2003] suggest that there seem to be more noise for BMO than AMC after the announcement is made. This happens because market has less time to interpret earnings information and investors may have divergence opinions.

Since most of the trades in reaction to earnings news in AMC occur immediately following the announcements (often within half an hour of the close of the market), we also conduct additional tests for the AMC sub-sample to study more closely the price efficiency for the period from the first trade after the announcement to 18:30. We regress the announcement-to-close return (r_{ac}) on the return from announcement to 18:30. The results (not reported for brevity) are qualitatively similar. The beta coefficient is at 1.076 and is significantly at the 1% level, indicating a slight overreaction in the AMC session.

TABLE 9

The Efficiency of Return

An earnings announcement occurs on day t=0, which begins with the first trade or quote following the most recent market close prior to the announcement and ends with the next market closing price after the announcement. For announcements that occur during the BMO, the announcement-to-close return is regressed on the return from the announcement-to-open. For announcements that occur during AMC, the return from announcement-to-close of day t=0 is regressed on return from the announcement to the following open.

$$r_{ac} = \alpha + \beta r_{ao} + \varepsilon_i \tag{8}$$

These simple OLS regressions are used to measure the efficiency of price as suggested by Biais, Hillion, and Spatt [1999]. One earnings announcement is treated as a single observation. The dependent variable is r_{ac} and the independent variable is r_{ao}. The sample consists of 582 stocks included in the S&P500 during the years 2004-2008. The earnings announcement days and times are from I/B/E/S. We match the stocks symbols and earnings announcement days from I/B/E/S with Compustat and Bloomberg to ensure data integrity. Panel A shows the regression result from the full sample. Panel B and C report the results separately for BMO and AMC. The t-statistics are reported in italic.

Panel A: The full sample	Coefficient Estimates	t-statistics
α	-0.001	-1.431
β	0.999	87. 24***
Panel B: The BMO sub-sample		
α	-0.001	-1.179
β	0.978	60.76***
Panel C: The AMC sub-sample		
α	0.000	-0.283
β	1.017	60.522***

***Significant at the 0.01 level

6. Robustness Test on the Impact of Macroeconomics Announcements

BMO earnings announcements may sometime coincide with the scheduled macroeconomic announcement such as unemployment, GDP or CPI. Adams, McQueen and Wood [1999] find a significant impact of inflation on large cap stock prices. Poitras [2004], however, finds that the announcement variables contribute very little to daily price changes and have weak explanatory power.

To investigate whether the macroeconomic announcements affect the price change and price discovery related to the earnings announcements of the firms, we run the regression analysis by adding the macroeconomic event as an additional dummy variable. We collect a set of macroeconomic announcements from the website during our study period.[10] To be consistent with prior studies, the macroeconomic variables we use are GDP, CPI, PPI and unemployment data. The GDP data is usually released on the last Friday of January, April, July and October for the previous quarter. Each quarter's data are revised in each of the following two months after the initial release. The unemployment data is usually released on the first Friday of the month. The CPI and PPI are usually released on the 11^{th} and 13^{th} business day of the month, respectively. All news is scheduled to be released at 8:30 A.M. (EST). The maximum possible number of each event is 60 distinct days.[11] We match each of the macroeconomic announcements with our S&P500 sample for BMO announcements. We find that 227, 56, 150 and 157 earnings announcements in our sample occur on the same day as the release days of GDP,

[10] www.econoday.com

[11] GDP are released on quarterly basis. With the initial release plus two revisions for each quarter, there are 12 event dates for each year. Employment and inflation data are released on monthly basis. Thus, for our 5 year sample period, we have 60 event days for all the variables considered.

unemployment, CPI and PPI, respectively. We set the dummy variable ECON equals 1 if one of these variables coincides with BMO announcement and 0 for no macroeconomic announcement or AMC announcements. We analyze the potential effect of macroeconomic events on both *WPC*s, price discovery from private information, and price efficiency. For brevity, we only present the results for the price discovery with the dummy ECON added in Table 10.

$$Price\ discovery = \alpha + \beta_1 Analysts + \beta_2 Surprise + \beta_3 Volume + \beta_4 Firm\_Size + \beta_5 AHspread + \beta_6 AMC + \beta_7 NYSE + \beta_8 ECON + \varepsilon \quad (9)$$

The results show that macroeconomic announcement in the morning does not materially change our findings. The dummy variable ECON is not statistically different from zero. The results on the *WPC*s and price efficiency are qualitatively similar. Therefore, our findings of AHT having significant impact on price discovery and price contribution subsequent to earnings releases are robust.

TABLE 10

Robustness Test on Concurrent Macroeconomic Announcements

We perform a robustness test on the determinants of price discovery in the regression framework by adding the ECON dummy variables.

$$Price\ discovery = \alpha + \beta_1 Analysts + \beta_2 Surprise + \beta_3 Volume + \beta_4 Firm\_Size + \beta_5 AHspread + \beta_6 AMC + \beta_7 NYSE + \beta_8 ECON + \varepsilon \quad (9)$$

The variables are the same as in regression (7) with an additional dummy variable ECON, where ECON equals 1 if GDP, unemployment, CPI or PPI data is released on the same day as the earnings releases in the BMO period, and 0 if there is no macroeconomic announcement. The t-statistics of the coefficients are reported in italic.

Independent Variables	1	2
Intercept	-0.1318	-0.0535
	-1.33	*-0.52*
Analysts	0.0013	0.0012
	1.47	*1.36*
Surprise	-0.0965	-0.0772
	-0.75	*-0.60*
Volume	0.0412	0.0390
	*4.55****	*4.31****
Firm_Size	-0.0215	-0.0231
	*-2.75****	*-2.97****
AHspread		-0.0114
		*-3.13****
AMC	0.0623	0.0669
	*4.35****	*4.66****
NYSE	-0.0521	-0.0475
	*-4.61****	*-4.18****
ECON	-0.0104	-0.0119
	-0.25	*-0.29*

***Significant at the 0.01 level

7. Concluding Remarks

After-hours trading (AHT) has gained interest from traders, researchers, and regulators in recent years. Even though trading volume is relatively low compared to the regular hours trading (RTH), AHT plays a significant role for the market to act upon corporate announcements which are concentrated during the before market open (BMO) or after market close (AMC) periods. We use a sample of stocks included in the S&P500 for the years 2004-2008, in which 95% of earnings announcements released either during BMO or AMC. Our study focuses on price reactions, price discovery and efficiency in AHT immediately following earnings announcements. Contrary to the thin trading often documented for AHT, we find that overall trading activity is heightened greatly on the earnings announcements days. Even though illiquidity remains an issue for AHT compared to RTH, we find higher level of liquidity on the event days. Investors act swiftly following the earnings announcements as we observe immediate price reactions in AHT. The trades during BMO and AMC periods contribute to 36% and 60% of price changes, respectively. Price discovery are also much higher for AHT following the event despite relatively low volume. As a result of AHT trading, the short term price changes after the announcements to the market open reflect the earnings news efficiently.

Our study clearly demonstrates the importance of AHT on days when corporate earnings are released outside of RTH. Given the current level of AHT volume, informed traders who have access to AHT are able to trade ahead of the majority of investors. Our findings also have implications for studies of PEAD as event studies around earnings announcements should not only take account the timing of the AHT announcements

(Berkman and Truong [2009]), but also the immediate market responses to the announcements.

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ESSAY 2

THE IMPACT OF LOW COST AIRLINE ENTRY ON COMPETITION, NETWORK EXPANSION AND STOCK VALUATIONS

I. INTRODUCTION

Major economic trends, including globalization and transition to a knowledge-based economy, have increased international and intra-national travel. As the dominant long distance passenger mode in the U.S., airlines have encountered a difficult period since 9/11 with decreases in passenger boarding in 2007. Following airline deregulation in 1978, the successful emergence of low cost carriers (LCCs) is one of the most important structural and financial developments in the airline industry. The concept originated in the U.S. and later spread to other parts of the world. What made the market highly susceptible to LCC entries were its oligopoly structure, entry barriers and high fixed costs.(Moore, Rubin, & Joy [2007]) By 2006, LCCs served one third (32.9%) of all domestic origin and destination passengers, and even not using them, about three-fourths of domestic passengers had access to LCC service (Daraban [2007]). Southwest Airlines, the pioneer of the low cost airline business model was the second largest U.S. carrier in terms of both passengers and market share in 2004-2006.

We posit two opposing effects of LCC entry on legacy airline profitability and stock prices. The airline industry represents a contestable oligopoly, where the major oligopoly participants may refrain from price maximization. Entry of low cost rivals with a more efficient cost structure and a different business strategy can significantly alter the competitive positioning of the legacy airlines. Thus, the first effect of increased competition points to a negative pressure on legacy airline margins. However, a positive network expansion effect of LCC entry is created through economies of scope and increased industry-wide connectivity. The spillover effect of expanded network points to increased revenues. Thus, the entry of low cost carriers into the airport markets of established airlines would be expected to impact the financial performance of the legacy airlines. We posit that the trade-off between competitive and spillover effects eventually determines the net impact on legacy airline stock prices. The objective of this paper is to explore the impact of LCC entry into a large airport on the direction and the magnitude of stock price changes of the six legacy airlines. This analysis extends previous research to present an event study of the dynamic stock market responses of the legacy, but contestable, oligopoly airlines to LCC entry into the hub or major market airports of the legacy airlines. The findings will improve understanding of the financial impact of the LCCs on stock values in the U.S. airline industry and may also inform policies and regulation of the airline industry in the U.S. Although we focus on the airline industry, the issues we have analyzed also have bearings in other network industries such as Bank branch versus ATMs, real estate MLS, telephone services and internet services, computer hardware and software among others.

We organize the rest of the paper into several sections focusing on the airline industry structure, literature review, discussion of competition versus network expansion or economies of scope, data and methodology, empirical results, and conclusions.

II. THE AIRLINE INDUSTRY

The 1971 entry of Southwest Airlines into Love-Field Airport of Dallas is often considered the initial effect of deregulation in the passenger airline industry. Incorporated in 1967, Southwest was facing legal action from the incumbent airlines when it announced its intention to start carrying passengers. Finally in late 1970, the United States Supreme Court upheld Southwest's right to fly (Texas State Historical Association [2008]). After that, the industry pushed towards deregulation which came in 1978 with the passage of the Airline Deregulation Act. Market forces led to the entry of many new airlines leading to a significant network expansion. Increased passenger traffic opened new business opportunities for all players in the industry. However, new entrants were confronted with an aggressive pricing strategy by the legacy carriers. Only a few start-up airlines were able to survive that era and position themselves in the market. At the end of the 20th century, new airlines (e.g. Frontier Airlines in 1994, JetBlue Airways in 1999) entered the market and were able to gain market shares due to their different business model based on a lower cost structure. Transport Research Board [1999] analyzed the routes that Southwest entered between 1990 and 1998 and found that on average passenger trips increased 174 percent. Other new carriers emulated the strategy that Southwest Airlines, and America West Airlines started in 1983 by offering even lower airfares. Although both business and leisure passengers benefited substantially from airline deregulation and subsequent reduced fares, the network airlines found themselves in a situation of competitive and financial difficulty. Since the late 1990s, the legacy carriers have been in a crisis mode, American Airlines being the only carrier of the big six legacy airlines that has not filed for bankruptcy (Bailey [2006]).

Comparing their business models and the unique structure of the airline industry, airlines can be divided into three main categories: legacy, low cost, and regional carriers. In the U.S., the term “legacy carriers” refers to the traditional airlines or “The Big Six” including: American Airlines, Continental Airlines, Delta Airlines, Northwest Airlines, United Airlines, and US Airways[1]. While most regional airlines, as the name suggests, focus on regional markets or serve as a feeder for a legacy carrier, most LCCs, as well as all the legacy airlines, serve cities across the United States. This study focuses on the impact of LCCs on the legacy airlines, with focus on the stock valuation effect as well as competitive and network expansion impacts of LCC entry into large airports served by the legacy carriers.

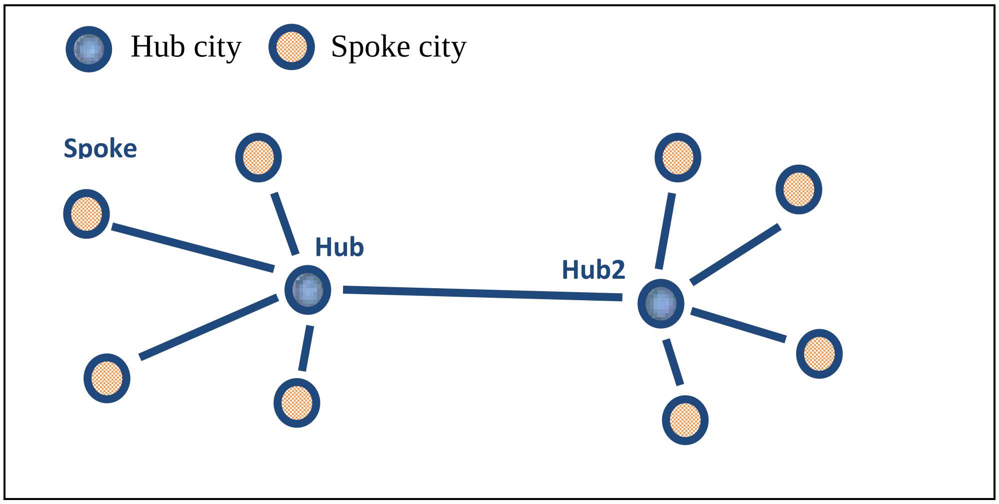
Legacy carriers are characterized by a hub-and-spoke system which has become the centrepiece of their business model. Delta Airlines developed the system in 1955 and created a hub at Hartsfield-Jackson Airport in Atlanta, GA. After the deregulation of the airline industry in 1978, American Airlines was given the lowest chance of survival due to its high cost structure (Daraban [2007]). However, the company implemented a new strategy which soon became a symbol of the legacy airlines. Starting with a hub in Dallas/Ft. Worth, TX, American Airlines concentrated departures and arrivals at certain airports in order to increase the probability of connecting outbound flights with inbound flights. In contrast to the previous model of point-to-point transit, passengers fly from their departure city along a spoke to a hub and board a flight on another, often major or longer, spoke to their destination. Airlines generally use large aircraft to serve these trunk-lines between hubs, and smaller airplanes for the connections of a hub to another

[1] The merger of Delta and Northwest Airlines in 2008 occurred subsequent to the period of this analysis, so that the six legacy carriers analyzed remained through 2007.

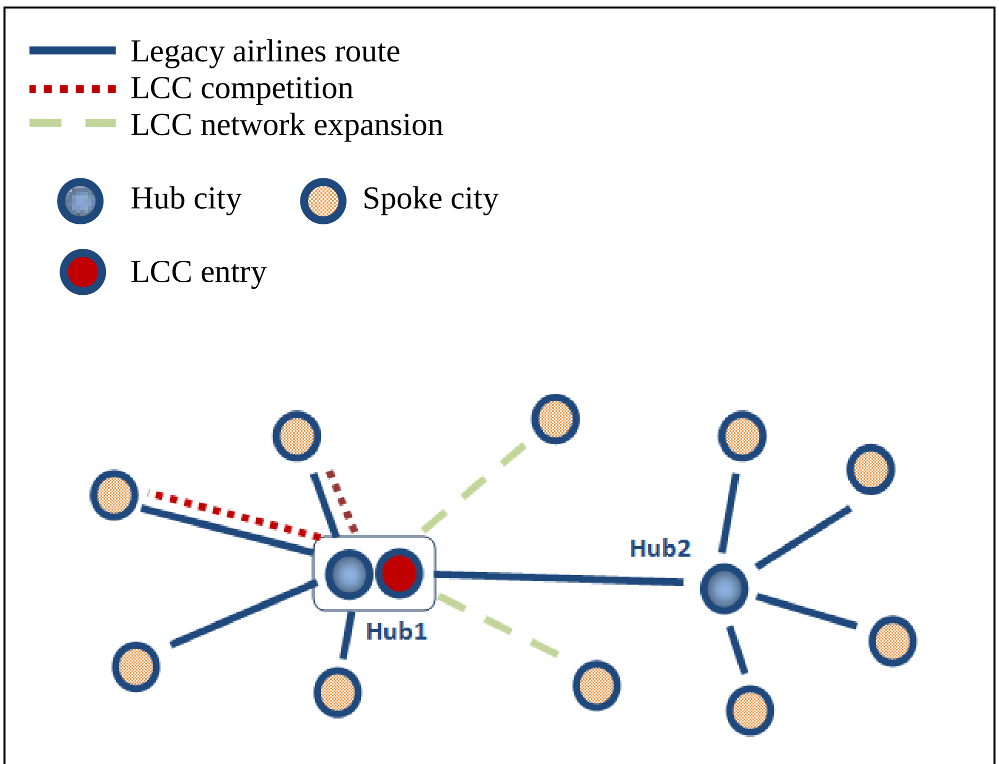
city along a spoke. The simple model of a hub and spoke network is shown in Figure 1 Panel A. The effects of competition and network expansion deriving from LCC entry are shown in Panel B discussed below.

Using the hub-and-spoke model, the legacy airlines try to achieve maximum connectivity while reducing less profitable routes, leaving the smaller routes to the regional carriers and LCCs. The combination of several nodes on one flight route creates cost efficiencies, because fewer flights are needed to connect the same number of cities. The hub and spoke model has been preferred by the legacy airlines as an airport system since it generates higher flight frequency and traffic between hubs and reduces passenger inconvenience from extra travel time (Brueckner [2004]). One essential characteristic of the hub-and-spoke system is that operating costs are largely fixed and independent of the number of passengers transported, so that, if there is a vacant seat, transportation of a marginal passenger has close to zero cost. Because of the lower costs and the extensive coverage of regional markets, a hub-and-spoke network represents a considerable, but penetrable, barrier of entry for new airlines (Rubin and Joy [2005]). Other characteristics of the legacy airline business model are the existence of different classes on an airplane, frequent flyer programs, airport lounges, and strategic alliances with other airlines, including both regional (e.g. SkyTeam, Star Alliance) and legacy (e.g. NWA with KLM and Delta and Continental) carriers.

A low cost carrier or low cost airline (also known as a *no-frills* or *discount* carrier) is an airline that offers generally low fares and eliminates many passenger services historically found in the legacy airlines. As of 2007, there are more than 20 low cost



Panel A. Hub-and-spoke model



Panel B. Competition and network expansion

Figure 1
The diagram depicts hub-and-spoke model
The model used by legacy airlines to achieve maximum connectivity between highly congested cities (hubs) and less congested cities (spokes).

airlines operating in the U.S. with some of these subsidiaries of the legacy airlines. In this paper, we include only the six largest LCCs that operate solely as low cost airlines; these six LCCs comprise 21.3% of the total 769.4 million domestic and international passengers flying in the U.S. in 2007 (BTS [2008]). Although some LCCs, like Frontier Airlines, also operate under a hub-and-spoke model, their business model is distinct from that of the established airlines.

LCC's lower operating cost structure is achieved by three different types of savings: distribution, product design, and overhead savings (Magill [2004]). First, distribution savings are achieved because flights can only be booked on-line instead of through travel agencies. Thus, the LCC airlines operate without computer reservation system fees or other travel agency commission fees, and they generally do not have frequent flyer programs. Second, product design savings are realized with different aircraft design. The LCCs not only operate airplanes with only one class, they also try to increase the number of seats in an aircraft by reducing legroom. Airlines that operate with a low cost structure are often known as no-frills airlines, referring to the non-availability of free food, beverages, and newspapers, as well as reduced flight service. More recently, the legacy airlines have also moved in the same direction to reduce costs wherever possible. The business model of typical low cost airline is usually based on a single type of airplane providing a substantial cost advantage from reduced training and maintenance cost, fast turnaround time allowing maximized aircraft utilization, and minimal diversity of equipment. Low cost airlines are less likely to be unionized and also practice a strategy of aggressive fuel hedging (Daraban [2007]). Finally, some LCCs reduce operational overhead by serving secondary urban airports, thereby avoiding high airport charges. All these factors make possible a reduced cost per available seat kilometre ($/ASK) of up to 50% (Magill [2004]).

Due to these substantial cost differences, LCCs are able to offer lower air fares and to penetrate markets of established airlines, despite the high barriers of entry in the airline industry. Entry barriers result not only from the hub-and-spoke system, but also from scarce landing slots at airports, as well as federal restrictions against foreign ownership of U.S. airlines that preclude the possibility of international investment. But the main barrier to entry is the existing oligopoly market structure of the airline industry, because a limited number of firms can set or change prices in the industry. Actions taken by any firm in an oligopoly are quickly noticed by its competitors and subject to swift reactions. This results in interdependence among the oligopoly companies because each airline knows that its market power is contestable or vulnerable to entry or other rival reactions (Rubin and Joy [2005]).

Oligopoly market power is usually measured by the industry concentration ratio, which relates the market share of the largest firms in the industry to the size of the entire market. As depicted in Figure 3, from February 2007 to January 2008, the market share of the so-called Big Six was almost 60% of all Revenue Passenger Miles. Southwest added another 12 % market share, leaving less than 30% to the remaining smaller airlines.

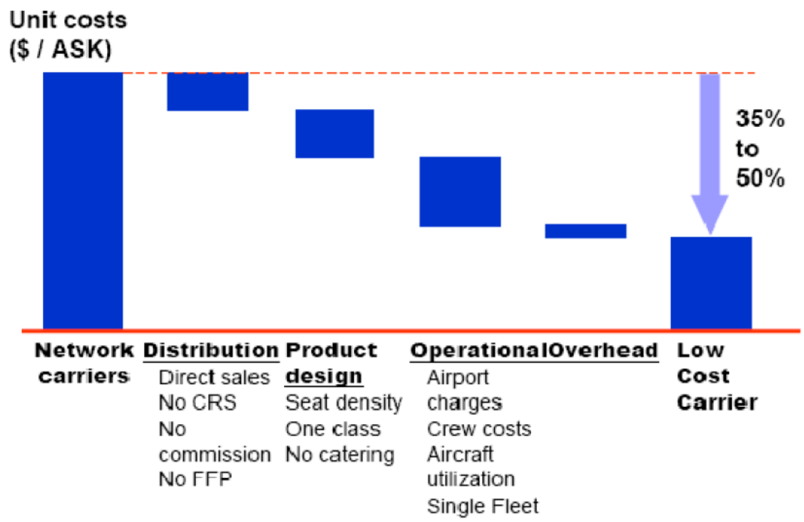


Figure 2

Comparison of cost structures between network legacy airlines and low cost carriers
Source: Magill, D. [2004], "Overview of the Low Cost Carrier Market Worldwide", 3rd Annual MIT Airline Industry – Washington DC Conference
Note: ASK=available seat kilometer; CRS=computer reservation system; FFP=frequent flyer programs

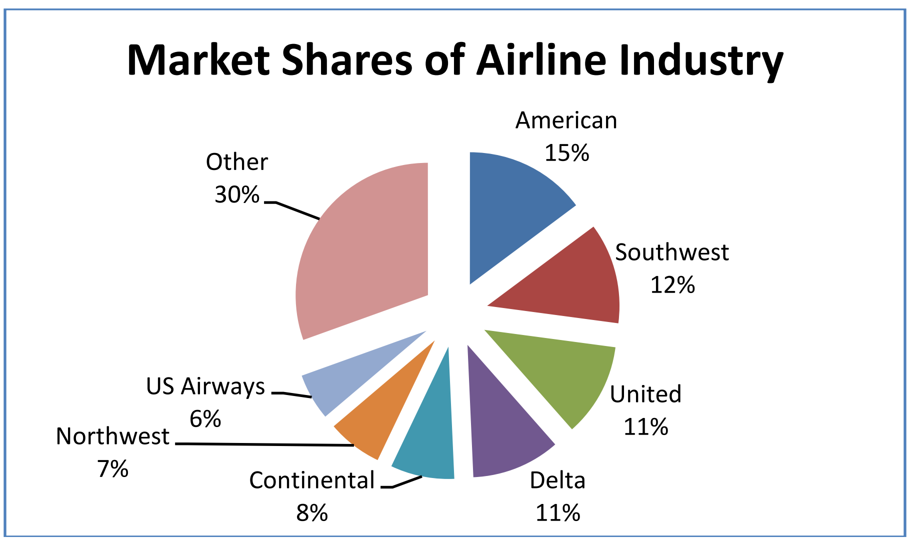


Figure 3

Market shares of airline industry by revenue passenger miles
Market shares of the six legacy airlines, Southwest Airline and others from February 2007 to January 2008.
Source: Website of Bureau of Transportation Statistics. Research and Innovative Technology Administration. http://www.transtats.bts.gov

III. LITERATURE REVIEW

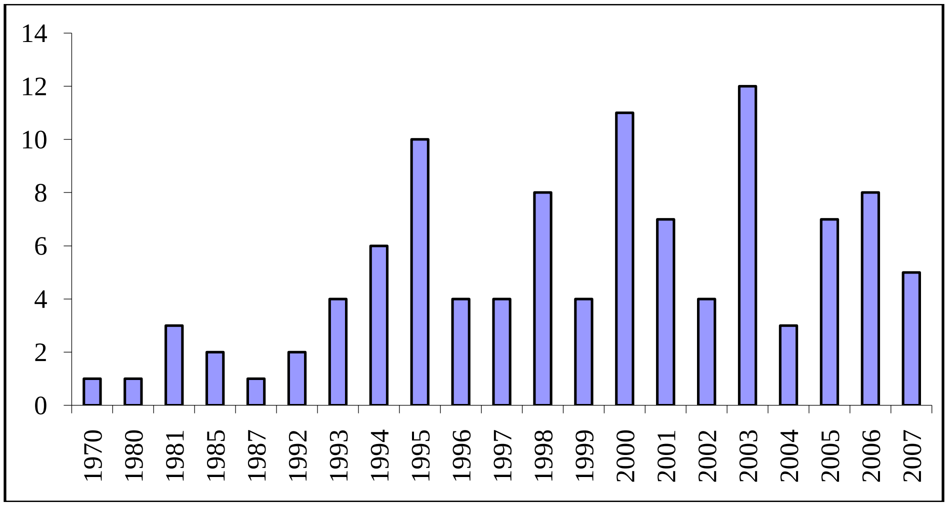
Substantial research on the entry of LCCs deals with the emergence and success of Southwest Airlines, the first and most successful low cost airline in the U.S. Bogulaski, Ito and Lee [2004] try to determine and quantify the factors and market characteristics that impact Southwest's entry decision. They search routes that are most likely to be entered and predict the implications on the legacy airlines, concluding that future entries of Southwest airlines are expected to increasingly affect the revenues of established carriers. Flouris and Walker [2005] examine the stock and accounting performance of three airlines (Southwest, Continental, and Northwest) in the aftermath of 9/11, finding dramatic changes in the airline industry and significant implications for the economic gains and future of most airlines. Focusing on the stock market's perception of the viability of low-cost versus full-service business models following 9/11, they concluded that, in the eyes of investors, Southwest's business model provides significantly more financial and operational flexibility than full-service airlines. The LCC business model has also been introduced in Europe and Latin America. Alderighi, Cento, Nijkamp and Pretveld. [2004] investigated the response of full service carriers or legacy airlines to the entry of LCCs into European markets. They find that when LCCs enter a market, the legacy airlines react by reducing their airfares with a larger impact on business class than leisure class fares. Oliveira [2008] studied the route choice model of Gol Airline's entry in Brazil, as the first LCC airline in Brazil and Latin America. Gol initially followed a strategy similar to that of Southwest Airline by focusing on short-haul and high density routes. It succeeded in penetrating the market and now has 13 percent market share and is the only profitable airline in that market. Beyond the impact of competition on pricing, Mazzeo [2003] studied the effect of competition on service quality, finding that flight delays are more prominent and longer on routes where airlines face less competition.

Other research addresses the impact of LCC entry on airfares. Several studies (Windle and Dresner [1995], Bennet and Craun [1993] and Morrison and Winston [1995]) find that LCC entry into the markets of established airlines significantly reduces ticket prices. More recently, Ito and Lee [2003] analyze the pricing behaviour of the legacy airlines that are impacted by LCC entry. They find that the incumbent response to an LCC entry is rarely aggressive, i.e. the incumbents adjust their airfares by lowering them but rarely try to undercut the LCC fares in order to squeeze the entrants out of the market. Dresner et al. [1996] find that airfares on a competitive route are lowered when an LCC enters a certain city pair. This approach takes into account consumers' willingness to drive to a nearby airport (e.g. Oakland, CA vs. San Francisco, CA). Similar behaviour is observed by WinburSmith Associates (WSA) [2007] in the Pittsburgh region. The study claims "in 2000, more than 193,600 residents of western Pennsylvania drove to Cleveland, Columbus and Akron, to take advantage of the competitive pricing offered by LCC at nearby airports." In addition to price adjustments in the case of an actual entry on a route, Goolsbee and Syverson [2005] find that incumbents adjust their fares even when the route is only threatened by LCC entry. In their study, a route is perceived as threatened when Southwest starts operating on both endpoints of the route but not the route itself. A recent study by Daraban [2007] on the impact of LCCs on airfares addresses several limitations of previous studies. He focuses on the arbitrage actions of travellers who select among alternative routes and, thus, generate a correlation of airfares on adjacent routes.

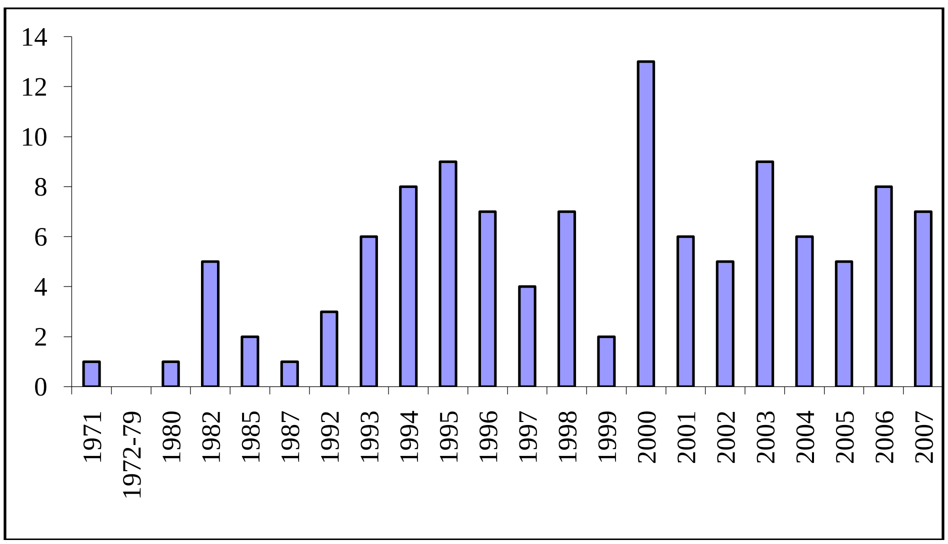
While the impact of LCCs on airfares and airline markets in general has been researched, the competitive effects of LCCs are not limited to their air routes and fares, but may also impact the stock valuation of legacy carriers when LCCs enter their hub or major markets. For example, Whinston and Collins [1992] conducted an event study analysis that is most similar to the approach used in this paper. They cover two years of entry announcements into airport-pairs by People Express (an LCC that operated in the U.S. from 1981 to 1987) to shed light on airline competitive structure and examine the stock price reactions of incumbent airlines to People Express entry announcements into various routes. We expand this body of research in several ways. First, we expand their two-year coverage of one LCC to look at the entry of six dominant LCCs during 30 years into 31 of the largest and hub airports of the six legacy carriers. We broaden the analysis of the effect of LCC announcements beyond the individual entry routes to the comprehensive strategies of airlines and their impact on overall stock valuations. Moreover, we examine the spillover effects of LCC entry in addition to the competitive effects. The extended time period, including such events as 9/11 and the shift from largely travel agent to on-line marketing and ticketing, etc., could potentially change the way LCC entry affects legacy airlines in recent times relative to the period studied by Whinston and Collins [1992].

Whereas focusing on individual LCC routes would be appropriate to understand airfare pricing issues, our research design pertains to the understanding of stock values. Stock returns are impacted by multiple considerations, and we note that a single LCC entry may impact multiple routes of multiple airlines on the same date. Moreover, the individual route decisions are often part of a large strategic corporate decision of airport entry keeping in mind potential competition and maximization of overall potential consumer base.

Our paper extends previous work by using both the dates of announcements and the actual entry dates into airports to determine whether LCC entry has a significant effect on competition and network expansion, as well as stock prices, of the established airlines in the 21st century. To analyze the impact of the announcement and actual entry of the six largest low cost carriers on the six legacy airlines, we apply both standard event study methodology and regression analysis to unique databases derived from original data searches.



Panel A. Number of LCC entry announcements by year: 1970-2007



Panel B. Number of LCC entries by year they began operations: 1970-2007

Figure 4

Number of announcements of low cost carrier entry by year

The low cost carriers included in the study are AirTran, ATA, Frontier, JetBlue, Southwest, and Spirit. The study includes events from the first Southwest Airline announcement in 1970 until 2007. There were no subsequent new entrants into the industry until the 1990s and there are some years with no LCC announcements or entries. Panel A depicts the number of announcements from 6 LCCs, 1970-2007. Panel B presents the number of LCC entries 1971-2007.

Sources: Websites of Airlines and Air Transport Association

IV. COMPETITION VS. NETWORK EXPANSION AND ECONOMIES OF SCOPE

We posit that competition and network expansion are two important effects of LCC entry. Economides and Salop [1992] provide a theoretical model and discussion of the trade-off between competitive and complementary effects in the context of network market structure. LCC entry may be a catalyst for price wars among airlines, as the incumbent legacy airlines face increased price competition when LCCs enter the airports they serve. In contrast, the complementarities emerge from new LCC routes and additional LCC passengers who previously did not have flight options from their respective cities.

Hurdle et al. [1989] show that the number of potential entrants affects market concentration measured by fares. For example, Wilbur Smith Associates (WSA) [2007] finds that airfares of US Airways, which dominated the Pittsburgh region, drop dramatically with the expansion of AirTran in this airport. Air fares in Pittsburgh declined 27% while average airfare in the U.S. increased about 7% (Wilbur Smith Associates [2007]). Most studies conclude unanimously that LCC entry adversely affects the fares charged by the legacy airlines, and these price-effects point to potentially lower profits and stock prices for legacy airlines. In our experimental design, observation of negative abnormal stock returns for legacy airlines indicates that the competition effect dominates.

LCC entry has both costs and benefits, as the incumbent airlines may also enjoy benefits from increased traffic connectivity when an LCC starts serving new routes. We show a simple model of LCC entry and its effects on competition and network expansion in Figure 1 Panel B. LCC entry into a market creates increased competition among incumbent airlines if they fly the same routes. When an LCC launches routes that were not operated previously by the existing airlines, it creates a network expansion effect in the market. WSA [2007] estimates an increase of more than 110,000 passengers visiting a region served by an LCC and new demand of more than 76,000 passengers from those who otherwise would not have travelled by plane. A similar study by Chmura Economics & Analytics [2006] reports the entry of two LCCs, AirTran in June 2005 and JetBlue in March 2006, into Richmond International Airport (RIC). The study shows that with these LCC entries, for the year 2006, the number of passengers in RIC increased by 400,000 passengers, a dramatic change from previous years, and average fares were reduced across airlines. Whinston and Collins [1992] find that fares of incumbents fell on routes both to the same city-pair and to other airports with LCC introduction.

However, the incumbents also benefit from a network expansion effect which refers to the benefit that a participant in a network derives from others. The utility that a user derives from consuming their products or services increases with the expansion of the network. Katz and Shapiro [1992] in their theoretical model of network externalities, competition and compatibility point out that “the central feature of the market that determines the scope of the relevant network is whether the products of different firms may be used together”. Their model suggests that even though competing firms will try to differentiate their services and dominate the market, the firms may also have an incentive to choose to create compatible product or services. The latter strategy, however, leads to an increase in size of the market. As a result, consumers benefit from a larger network. In the airline industry, traditional carries can benefit by connecting passengers from unserved origins to the served destinations, and vice versa, if the LCC introduces new routes that are not served currently by the airline. Since the routes from origin and destination cities of LCCs are more limited, and the legacy airlines have more comprehensive routes than LCC airlines, the network benefit of LCC entry to the traditional airlines can outweigh the competitive losses. Hallowell [2000] proposes that economies of scope in passenger airline cargo benefit overall operations, as long as the airlines earn marginal revenues higher than marginal costs on cargo, because their existing assets (aircraft) are utilized more efficiently.

A study by the European Parliament [2007) on the growth of low-cost airlines in European markets concludes that LCC development benefits the relevant macroeconomies. It brings new traffic demand for existing and newly developed airports and also creates additional traffic flows on newly created routes that were not previously served by legacy airlines. It creates a significant impact on regional economies since LCCs tend to choose regional airports to complement their business model. As a result, some little known or underdeveloped regions become more visible when promoted by LCC advertisement so that both regional and legacy airports mutually benefit from enhanced economic development.

In our regression analyses, we focus on the two key variables of competition and network expansion and control for several other factors that may affect stock prices. We hypothesize that the level of competition should have a negative effect on the returns of legacy airlines while network expansion should have a positive effect, so our two hypotheses are:

H1: An increase in airline industry competition due to LCC entry is negatively associated with returns of the legacy airlines.

H2: An increase in airline network expansion due to LCC entry is positively associated with returns of the legacy airlines.

We test these two hypotheses with both announcement and entry dates. The drift after announcements and additional effects on implementation are not a completely rare phenomenon. The entry announcements do not contain information about airfare pricing, plane sizes, and other details which are important determinants of overall profitability. We also note that these findings are consistent with the broad conclusion that spillover effects (known fully only after implementation) of LCC entry outweigh competitive impacts (already known upon announcement).

V. DATA AND METHODOLOGY

V(i). *Data*.

To conduct this study, data was collected and datasets developed for the following: the established carriers and the low cost carriers, major and hub airports, LCC announcement and entry dates for 1971 through 2007, and the relevant daily stock prices of the legacy airlines during this period. Because manual collection of LCC announcement and entry dates constituted an extensive and time-consuming process, we limit the number of events by focusing on the 30 largest U.S. airports and four additional hub airports of the six major carriers. We obtain data from several sources. First, the Bureau of Transportation and Statistics, Research and Innovative Technology Administration (RITA) provides a long history of very comprehensive data on air traffic since 1990. Table 1 Panel A presents basic data for the six legacy airlines whose stock prices are analyzed, including: American Airlines, Continental Airlines, Delta Airlines, Northwest Airlines, United Airlines, and US Airways. The seventh network carrier, Alaska Airlines, is more limited in scope and is not generally considered among the legacy airlines and is not included in this study.

TABLE 1
PASSENGERS ENPLANED AND OPERATING REVENUES FOR LEGACY AIRLINES AND LOW COST CARRIERS

	Established	Passengers Enplaned in 2006 (Thousands)[a]	Operating Revenues in 2006 (Millions)[b]
Panel A. Legacy Airlines			
American Airlines	1934	98,142	22,493
Continental Airlines	1934	46,738	13,010
Delta Airlines	1929	72,524	17,339
Northwest Airlines	1926	54,837	12,555
United Airlines	1926	69,265	19,334
US Airways	1939	57,659	11,845
Panel B. Low Cost Carriers			
AirTran Airways / ValuJet Airlines	1993	20,033	1,893
ATA Airlines	1973	2,624	752
JetBlue Airways	1999	18,507	2,363
Frontier Airlines	1994	8,895	1,131
Southwest Airlines	1967[c]	96,276	9,086
Spirit Airlines	1980	4,477	540

Sources: Websites of Airlines, Air Transport Association, 2006 ATA Annual Report, www.airlines.org.
[a] Scheduled Services only,
[b] All Services (including charter service).
[c] Southwest was incorporated in 1967, but started flying in 1971.

While the established airlines are widely recognized, the selection process for the low cost carriers whose entries were to be examined was more complicated, mainly because no definitive list of the largest LCCs by an official source was found. Thus, to determine the optimum number of LCCs for analysis, the first approach was an Air Transport Association [2007] list that includes every airline in the United States, from which we eliminated the smaller regional and charter airlines, as well as all cargo carriers. The issue of defining a threshold for LCC inclusion remained, as study criteria could have been market shares or passengers. We first excluded airlines that had previously been large LCCs but have gone out of business. Ultimately, financial data reports by the Bureau of Transportation Statistics proved helpful because they list financial figures of a 21-carrier group that includes the seven largest network, regional, and low cost airlines (U.S. Department of Transportation [2007]). The selected group of six LCCs (AirTran Airways, ATA Airlines, Frontier Airlines, JetBlue Airways, Southwest Airlines, and Spirit Airlines) described in Table 1 Panel B provides the dominant LCCs that fit the research criteria.

Research on the selected LCCs raised further issues related to the carriers. First, there was the merger of America West Airlines with US Airways in 2005. America West was started in 1983 and became the second largest LCC in the U.S, but its merger with US Airways, completed in late 2007, resulted in a change of business strategy for US Airways. Although the airline now considers itself a low cost carrier, the recent change in its business strategy was completed after the last entry date of this study sample (US Airways Annual Report [2006]), and as such, in this research, US Airways is included as a legacy network airline. However, due to the merger with US Airways, no data was available on America West's destinations and announcement or entry dates into new airports. Thus, America West Airlines had to be eliminated from this analysis, leaving only six LCCs in the sample.

Additional LCC issues concerned AirTran and ATA airlines. First, AirTran Airways, a small airline based in Orlando, FL, was bought by ValuJet in 1997. Following a serious ValuJet airplane crash near Miami, FL and consequent FAA investigation, the airline's reputation declined. Due to the crash ValuJet was forced to reduce its operations, and it subsequently bought AirTran and adopted the AirTran name (Huettel [2006]). Second, in 2004, ATA Airlines filed for bankruptcy and substantially reduced its operations, withdrawing from numerous airports and leaving a gap that a code-share agreement with Southwest Airlines was supposed to fill. A code-share agreement is an accord between two airlines that allows customers of one airline to take connecting flights of the other without booking two different flights. Ticketing and airline codes are provided by either of the two airlines. After a period of reorganization, ATA again filed for bankruptcy on April 2, 2008, discontinuing all operations and cancelling all flights. In addition, Spirit Airlines is an LCC that operates from Florida and mainly serves Caribbean destinations.

Further data determination concerns the selection of the airports for analysis. The sample selected needed to include all the hubs of the established carriers, in addition to major non-hub airports out of the total of 566 functioning U.S. airports (FAA [2006]). Table 2 shows the 30 largest airports by total number of passengers as of 2006, plus three additional hub airports (Cleveland, St. Louis, and Memphis) that are included in order to encompass all the hubs of the six legacy carriers. Total passengers are measured as all arriving and departing passengers, with direct transit passengers counted only once. The ranking was taken from the Airports Council International – North America, whose members account for more than 95% of domestic passenger traffic in North America[2]. Honolulu Airport (HNL) and Cincinnati (CVG) entries are excluded from our test because exact announcement dates can not be obtained. Toronto-Pearson Airport (YYZ), one of the largest airports in North America, is not included in this study, which focuses only on U.S. airports. Therefore, our final sample contains announcements and entries of LCCs in thirty one airports.

Announcement and entry dates for each of the six largest LCCs into these airports were individually retrieved from the airlines' websites, press releases, and the Lexis Nexis database for1971 to 2007. There are a total of 110 announcement dates and 109 entry dates in our sample. In some cases, announcement dates are missing or not reported, so we note that not all entries have announcement dates. Also the entry or announcement of each of the LCC carriers into any one of the 31 airports is counted as a single event. Since our study focuses on understanding stock valuation changes, we avoid the econometric problems of clustered route analysis by counting the LCC entry decision into an airport as a single strategic decision. Whereas focusing on individual LCC routes would be appropriate to understand airfare pricing issues, our research design focuses on the understanding of stock values. We believe this is a conservative approach to assess the impact of entries on stock returns. The statistical significance of our results would be higher if the number of observations was based on the number of routes instead of the

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[2] Toronto-Pearson Airport (YYZ) is one of the largest airports in North America but was not included in this study, which focuses only on U.S. airports.

TABLE 2

THIRTY LARGEST AIRPORTS PLUS ADDITIONAL HUB AIRPORTS BY TOTAL PASSENGERS

Rank	Airport	Total Passengers in 2006	Number of LCC entries from 1971-2007
1	Hartsfield-Jackson Atlanta (ATL)	84,846,639	4
2	Chicago O'Hare (ORD)	77,028,134	2
3	Los Angeles (LAX)	61,041,066	3
4	Dallas/Ft. Worth (DFW)	60,226,138	4
5	Denver (DEN)	47,325,016	5
6	Las Vegas (LAS)	46,193,329	7
7	JFK-New York (JFK)	43,762,282	1
8	Houston (IAH)	42,550,432	6
9	Phoenix Sky Harbor (PHX)	41,436,737	4
10	Newark (EWR)	36,724,167	3
11	Detroit (DTW)	35,972,673	4
12	Minneapolis/St. Paul (MSP)	35,612,133	3
13	Orlando (MCO)	34,640,451	4
14	San Francisco (SFO)	33,574,807	6
15	Miami (MIA)	32,533,974	2
16	Philadelphia (PHL)	31,768,272	3
17	Toronto Pearson (YYZ)	30,972,577	-
18	Seattle-Tacoma (SEA)	29,693,949	5
19	Charlotte (CLT)	29,693,949	2
20	Boston Logan (BOS)	27,725,443	5
21	LaGuardia-New York (LGA)	26,571,146	5
22	Dulles-Washington DC (IAD)	22,813,067	4
23	Salt Lake City (SLC)	21,557,656	3
24	Ft. Lauderdale/Hollywood (FLL)	21,369,787	4
25	Baltimore/Washington (BWI)	21,184,208	3
26	Honolulu (HNL)	20,067,871	-
27	Tampa (TPA)	18,867,541	4
28	Chicago Midway (MDW)	18,680,663	4
29	Reagan-Washington (DCA)	18,545,557	5
30	San Diego (SAN)	17,481,942	5
Additional Hub airports:			
	Cincinnati (CVG)	16,244,962	-
	St. Louis (STL)	15,205,944	5
	Cleveland (CLE)	11,321,050	1
	Memphis (MEM)	11,176,460	2
			Sum: 118

Sources: Airports Council International – North America, Websites of Airlines number of airport entries. We note that stock returns are impacted by multiple considerations, and a single LCC entry may impact routes of multiple airlines on the same date.

We also find that there are more than 40 distinct announcements and entries for the time period between the crisis caused by the terrorist attack of September 11, 2001 and 2007. The major airports are in key U.S. industrial cities, all being served by the established carriers.

Further, due to the scarcity of landing slots or gates at these critical airports, the legacy airlines rarely give up slots once they have acquired them, and as a result, the presence of the long-term legacy airlines is assumed in the major U.S. airports prior to more recent LCC entry. We are able to infer the existence of each airline on all 31 airports from the Airline Origin and Destination Survey (DB1B) database from the BTS website[3]. The DB1B data contains all low cost carrier entry and announcement dates from 1993 to 2007. This period represents 93% of announcement dates with the remaining 7% occurring during 1970 to 1992. We explicitly verified the presence of all legacy airlines in all airports analyzed from 1993 onwards.

The stock prices of the legacy airlines were retrieved from the Center for Research in Security Prices (CRSP) database, in order to analyze the impact of LCC announcements and entries on the stock prices of the network legacy airlines. While the maximum potential sample is 660 announcement dates and 654 entry dates, due to mergers and bankruptcies, the stock prices of some airlines are not available during

[3] The Airline Origin and Destination Survey (DB1B) is a 10% sample of airline tickets from reporting carriers. Data includes origin, destination and other itinerary details of passengers transported. The existence of an airline in a particular airport can be inferred from non-zero and non-missing number of passengers in origin/destination airport.

certain periods of time. This reduced the sample data to a total of 566 LCC announcement dates and 511 LCC entry dates, as shown in Table 3.

TABLE 3
NUMBER OF LOW COST CARRIER ANNOUNCEMENT AND ENTRY DATES PER LEGACY AIRLINE

Airline	American Airlines	Continental Airlines	Delta Airlines	Northwest Airlines	United Airlines	US Airways	Total
Announcement Dates	107	103	93	86	87	90	566
Entry Dates	98	93	82	73	77	88	511

Note: A single LCC entry into one airport can affect numerous legacy airlines.

V(ii). *Methodology*.

Two separate methodologies are used in this paper: stock price event studies and regression analysis. The first approach derives from the seminal event study methods of Brown and Warner [1980], which tests security price performance surrounding an event date by calculating a cumulative abnormal return (CAR), defined as the summation of three-day abnormal returns (AR) enveloping the event day: namely the day before the event day, the event day, and the day following the event day. The calculation is based on a market model in which the AR of any security is calculated as the actual return in period t in excess of the market return in the same period. The market portfolio consists of a linear combination of the securities in the S&P 500 Index obtained from Yahoo Finance. Thus, the expected returns for any security should equal expected market returns. An abnormal or excess return of a security *i* in period *t* ($AR_{i,t}$) is the difference between the return of security i in period t ($R_{i,t}$) and the expected market return expressed as the daily S&P 500 return in period t ($R_{m,t}$):

$$AR_{i,t} = R_{i,t} - R_{m,t} \quad (1)$$

$$CAR_i = \sum_{t=1}^{3} AR_{i,t} \quad (2)$$

Then we cumulate the abnormal returns (CAR) for three days, (t-1, t, and t+1), relative to the event date, in recognition that investors could obtain information from rumors about an entry as well as news leaks about the company on the day before the actual announcement, or they could obtain their information from newspaper reports of entries the day after the actual occurrence.

To examine a broader view of LCC entry into the industry, we look at quarterly data for stock returns and examine the effects of competition and network expansion. We hypothesize that LCC entry not only increases competition in the industry but also expands the number of airline travelers. Because positive returns of the legacy airlines result from investor expectations about competition and revenue expansion, we estimate a system of simultaneous equations using two-stage least squares (2SLS) to test our hypotheses.

First, we posit that when LCCs enter the market, the level of competition in the industry will increase and the concentration level as measured by the Herfindahl-Hirschman Index (HHI) will decrease. We compute the Herfindahl-Hirschman Index (HHI) based on RPM, and use it to assess the level of market concentration. HHI is calculated by giving more weight to firms with larger market shares.

$$HHI = \sum_{i=1}^{n} marketshare^2 \quad \text{where n = number of firms in the industry.} \quad (3)$$

If the market share is represented as a percentage, the maximum value of HHI is 1.00, which occurs when one firm dominates the market (monopoly). Therefore, the lower the HHI value, the more competition exists in the market, and the higher the HHI the lower the competition. In our study, the HHI is an inverse proxy for competition, and we expect the legacy airlines to experience higher profit and stock returns if they face less competition.

Second, network externalities are created by an expansion of the base number of travelers. We use revenue passenger miles[4] (RPMs) as a proxy for network expansion or economies of scope. Unlike either the number of passengers or total airline revenues alone, which are also available on RITA website, RPM provides a better measure because it takes into account both revenues and number of passengers of the airlines.

An increased number of LCCs in the network will encourage travelers to fly more at the affordable prices. LCCs bring more passengers from different routes and smaller cities where no major carrier service connects to the hub-and-spoke system of the major carriers. We expect that RPMs of legacy airlines will also be positively related to LCC entry.

Because our hypothesis is multifaceted, we use the system of equations of two stage least squares in which quarterly returns of the legacy airlines, changes in the level of competition, and change in revenue passenger miles are the endogenous variables.

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[4] A Revenue Passenger Mile (RPM) is defined as one passenger transported one mile in revenue service. Revenue passenger miles are computed by summation of the products of the revenue aircraft miles on each inter-airport segment multiplied by the number of passengers carried on that segment. http://www.transtats.bts.gov

$$HHIRPM = \beta_0 + \beta_1 LCC + \beta_2 PaxIndustry + \eta_1 \quad (4)$$

$$RPM = \gamma_0 + \gamma_1 LCC + \gamma_2 GDPService + \nu_1 \quad (5)$$

$$R_{i,q} = \alpha_0 + \alpha_1 HHIRPM + \alpha_2 RPM + \alpha_3(Rm\text{-}Rf) + \alpha_4 SMB + \alpha_5 HML + \varepsilon_1 \quad (6)$$

Equation (4) measures the change in the level of competition using quarterly RPMs of the entire industry, where LCC is the number of entries of low cost carriers during the quarter. The announcements of LCC entries are not included because announcements do not affect either the number of passengers or revenues of the legacy airlines. We count the number of LCC entries reported in the Lexis-Nexis database and news releases in the LCC websites. We also include the change in the total number of passengers in the industry as a control variable. The coefficient β_1 is expected to be negative, which indicates the inverse relationship between an LCC entry and the level of concentration, providing a reverse measure of competition.

Equation (5) measures the change in RPMs of each legacy airline. The number of LCC entries is an exogenous variable; and the growth in GDP in service industries is also included as a control variable. The coefficient is expected to be positive, which indicates a positive relationship between LCC entry and network expansion.

In equation (6) we use the predicted value of the change in concentration and the change in network expansion as independent variables to predict the endogenous variable returns of the legacy airlines. We also include the Fama-French three factor benchmarks as control variables. Fama and French [1993] present a model in which stock returns can be explained by three factors: 1) the excess return on the market (Rm-Rf); 2) the size premium, which is the average return on three small portfolios minus the average return on three big portfolios (SMB); and 3) the book to market ratio premium, which is the average return on two value portfolios minus the average return on two growth portfolios (HML).

We also test for the existence of multi-collinearity in the model to statistically ensure the validity of our assumption that the variables used in the models are capturing different aspects of the industrial economics. For example, in equation (4), the Herfindahl index (HHIRPM) and RPMs are measured at airline level whereas the total of passengers (PAXIndustry) is aggregated at the industry level. Thus the competitive effects should show up in the RPMs but will have no effect on aggregated PAX. On the other hand, spillover effects will affect aggregate PAX. We employ a classical econometric test for diagnosing collinearity problems – the variance inflation factor (VIF) which is the reciprocal of tolerance (Belsley, Kuh and Welsch [1980]). The high values of VIF indicate a possibility of multi-collinearity. A value of 10 or higher for VIF (or 0.1 for tolerance) is often used as the threshold to consider multi-collinearity to be a problem.

VI. RESULTS

For an LCC serving a new airport, Table 4 shows the three-day cumulative abnormal returns (CAR) enveloping the announcement dates and shown separately for entry dates. We find that all cumulative abnormal returns are positive on both announcement and entry CARs and are significant and different from zero at a 0.05 level. The announcement CAR of the overall sample ranging from 1970 to 2007 is 0.623% and on the entry CAR is 0.825%. For the period from 1993 to 2007 during which we are able to verify the existence of all six legacy airlines at all thirty one airports, we also observe positive CARs of 0.34% and 0.89% on announcement and entry dates, respectively. The results are surprising in the context of previous academic research since the market seems to respond positively to LCC entrance. Thus, we conduct additional robustness analysis. To compare the CARs between event and non-event months, we identify non-event months as those months in which there is no LCC entry or announcement and compute the CARs for each day in those months. We then compute rollover 3-day cumulative abnormal returns for non-event months and average across the entire period. Results are shown in Table 4, panel B. The non-event CAR of the entire period is 0.058% and of the 1993-2007 sub-period is -0.152%. We show in panel C that using either a pooled test or Satterthwaite test[5], differences of CARs between announcement dates and non-event dates, and entry dates and non-event dates are positive and statistically significant, supporting our hypothesis about positive spillover effects.

[5] The pooled test assumes that the two populations have equal variances and it uses degrees of freedom n1+n2-2, where n1 and n2 are the sample sizes for the two populations. The Satterthwaite tests do not assume that the populations have equal variances and it uses the Satterthwaite approximation for degrees of freedom.

TABLE 4

ABNORMAL RETURNS AND CUMULATIVE ABNORMAL RETURNS SURROUNDING DATES OF LOW COST CARRIER (LCC) ANNOUNCEMENT AND ACTUAL ENTRY

Cumulative abnormal returns (CAR) of major airline stocks are computed for the three-day period enveloping the announcement dates and separately for actual entry dates of LCCs. The calculations are based on a market model, in which abnormal return (AR) of any securities is calculated as $AR_{i,t} = R_{i,t} - R_{m,t}$, where $AR_{i,t}$ is the abnormal or excess return of security *i* on day *t*. $R_{i,t}$ is the return of a security *i* and day *t*. $R_{m,t}$ is the daily S&P500 return on day *t* obtained from Yahoo Finance. The ARs on the day preceding the event, event day, and the day following the event are then cumulated to obtain CAR(-1,0,+1) in Panel A. The analysis is conducted using the full sample period from 1970 to 2007 as well for a reduced sample periods from 1993 to 2007 when the presence of all six legacy airlines on each of the 31 biggest airports can be verified using the DB1B dataset. In Panel B, we present the average three-day CAR for non-event periods by excluding the months in which an announcement or an entry occurs. The differences between event and non-event returns are presented in Panel C. The pooled test assumes that the two populations have equal variances and uses degrees of freedom n1+n2-2, where n1 and n2 are the sample sizes for the two populations. The Satterthwaite tests do not assume that the populations have equal variances and uses the Satterthwaite approximation for degrees of freedom.

Panel A. Market Model for the sample from 1970 to 2007 and subsample from 1993 to 2007

	1970 - 2007		1993 - 2007	
	CAR(-1,0,+1)	t-statistic and significance	CAR(-1,0,+1)	t-statistic and significance
Announcement Dates	0.623%	*2.130***	0.340%	*1.092*
Entry Dates	0.825%	*2.521***	0.892%	*2.530***

Panel B. Average three day CARs in the Non-Event Months with no announcement or entry.

	1970 - 2007		1993 – 2007	
	CAR(-1,0,+1)	t-statistic and significance	CAR(-1,0,+1)	t-statistic and significance
Non-event Returns	0.058%	1.736*	-0.152%	-1.650*

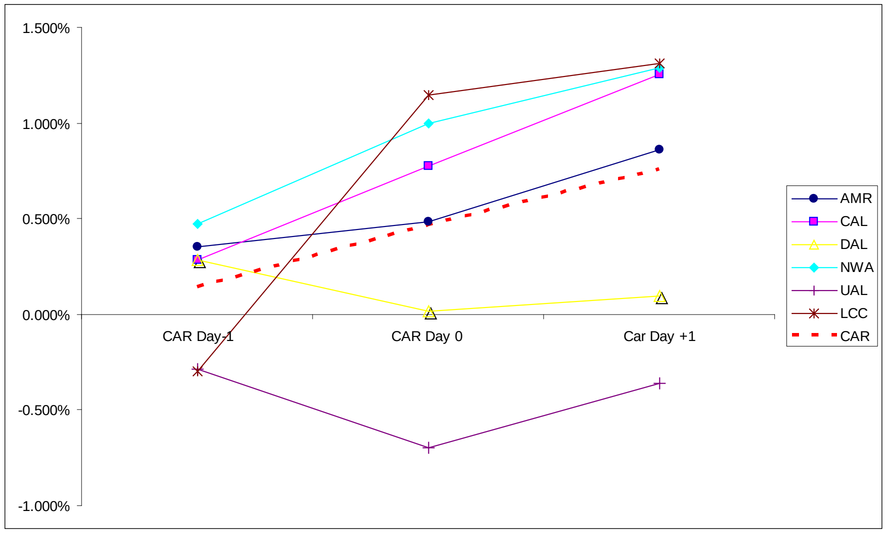
TABLE 4
ABNORMAL RETURNS AND CUMULATIVE ABNORMAL RETURNS SURROUNDING DATES OF LOW COST CARRIER (LCC) ANNOUNCEMENT AND ACTUAL ENTRY (CONTINUED)

Panel C. Difference between Event Returns in Panel A and Non-Event returns in Panel B.

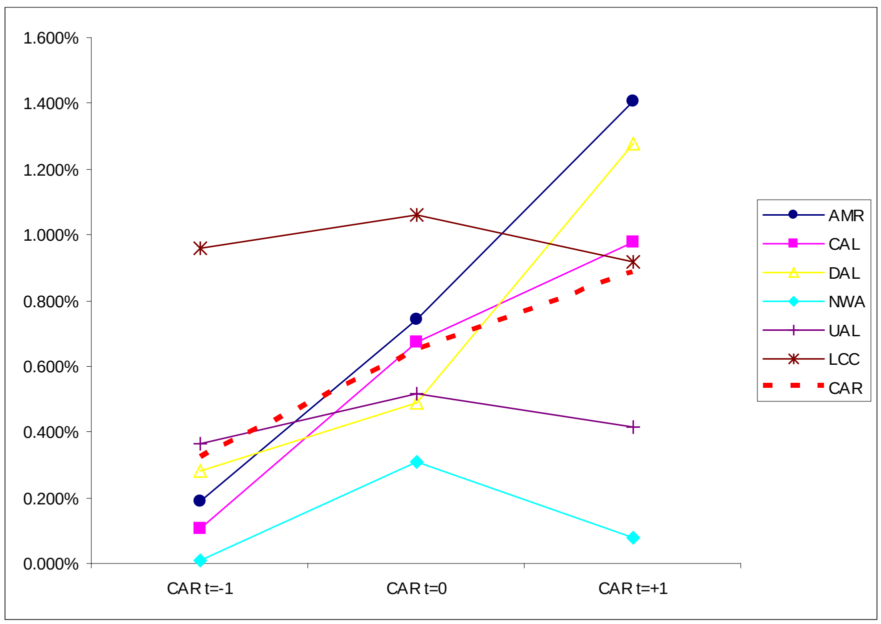
	1970 - 2007			1993 – 2007		
	Difference in CAR	Method	tValue	Difference in CAR	Method	tValue
Announcement minus non Event	0.565%	Pooled	2.12**	0.492%	Pooled	1.36
		Satterthwaite	1.92*		Satterthwaite	1.52
Entry minus non Event	0.767%	Pooled	2.73***	1.044%	Pooled	2.74***
		Satterthwaite	2.33**		Satterthwaite	2.87***

*, **, and *** indicate statistical significance at 0.10, 0.05 and 0.01 levels respectively based on a paired t-test.

We perform additional sub-sample analysis to ensure that it is in line with Whinston and Collin [1992] who find negative returns from the entry of People Express during 1984–1985. Looking at the same period for the airlines that we analyze, we also obtain negative average returns of -0.06% (t-stat -0.23) during 1984–1985 in response to People Express entry. During the same period our sample has another entry by Southwest Airlines with an announcement date on February 11, 1985 and entry date on March 17, 1985. The abnormal returns on these dates were also negative at -1.26% (t-stat -3.17) and -1.28 (t-stat -3.03). However, these negative returns seem to pertain only to these very early periods. Our overall sample, as well as the more recent periods within the sample, is associated with positive announcement returns of 0.62% (t-stat 2.13) and positive entry date CARs of 0.83% (t-stat 2.52) as shown in Table 4. Thus, the positive spillover effects seem to dominate the negative competitive effects in the more recent periods.Overall, our analysis produces some unexpected results relative to conventional wisdom on the issue of LCC entry. The entry or announcement of an LCC entry into a new airport was considered to be an event that would negatively affect the stock returns of the established airlines at that airport, because market entry of new competitors was assumed to potentially reduce the market shares of the legacy airlines. However, only the announcement and entry into hubs of the network carriers represent events that negatively affect the stock as anticipated, although these results are not statistically significant. This result at first appears counter-intuitive. As reported and depicted in Figure 5, most of the major airlines have positive CAR during the three-day event window with an almost 1% return, except United Airlines which shows negative returns. For the entry event, all airlines also show positive response to the entry of LCCs with almost 1% CAR over the three-day window.



Panel A. Announcement Days.



Panel B. Entry Days.

Figure 5

Cumulative Abnormal Returns of Legacy Airlines on Low Cost Airlines.

The cumulative abnormal returns (CAR) of six major airline stocks around announcement dates and entry dates of LCCs from the market model are illustrated. The cumulative abnormal returns (CAR) is reported for the day before the event (t=-1) to the day after the event (t=+1).

Table 5 presents the 2SLS estimate of the system of equations. Panel A presents the estimates for the impact of LCC entries on airline industry competition in equation (4). The coefficient of LCC is negatively correlated with airline industry Herfindahl index. The coefficient estimate is significant at the 0.05 significance level. Thus, LCC entry has the hypothesized impact of increasing competition which points to reduced pricing power and profitability of the legacy airlines. The coefficient on change in number of passenger travelling by planes, which is our control variable, is positive and significant at the 0.01 level. This implies that the greater the number of passengers travelling, the higher the level of competition in the industry. This makes sense because entry to new routes by both legacy airlines and low cost carriers becomes more attractive when there is a potentially larger demand.

To assess the multicollinearity issues, the tolerance and VIF are reported in columns 5 and 6. We find that all the VIFs in our models are less than 1.43 (ranging from 1.02 to 1.43), which is well within the values of 10 or higher for VIF, an often used as the threshold to consider multi-collinearity to be a problem (Belsley, Kuh and Welsch [1980]). Therefore, we can be confident that the variables in our models do not suffer from multi-collinearity problems.

TABLE 5

TWO-STAGE LEAST SQUARES REGRESSION RESULTS

The first stage regressions are estimates of the effects of LCC entry on competition and network expansion. The predicted value of changes in competition and network expansion are then used in the second stage to estimate the effect on the legacy airline stock returns.

$$HHIRPM = \beta_0 + \beta_1 LCC + \beta_2 PaxIndustry + \eta_1 \quad (4)$$

$$RPM = \gamma_0 + \gamma_1 LCC + \gamma_2 GDPService + \nu_1 \quad (5)$$

$$R_{i,q} = \alpha_0 + \alpha_1 HHIRPM + \alpha_2 RPM + \alpha_3 (Rm\text{-}Rf) + \alpha_4 SMB + \alpha_5 HML + \varepsilon_1 \quad (6)$$

$R_{i,q}$ is the return of legacy airline i in quarter q. Other than for stock returns, the subscripts i and q are not shown for simplicity. ΔHHIRPM is the percentage change in level of concentration as measured by Herfindahl-Hirschman Index, using revenue passenger miles (RPM) from every passenger airline in the industry in quarter *q*. ΔRPM is the percentage change in RPM of the legacy airline *i* in quarter *q*. LCC is number of low cost airline entries in quarter q. Rm-Rf, SMB, and HML are the 3 benchmarks from the Fama and French [1993] three factor model. ΔPaxIndustry is the entire industry percentage change in number of passengers travelling by plane. ΔGDPService is the percentage change of quarterly GDP in the service industry. The error terms are ε_1, η_1, and ν_1.

Panel A: LCC Entry Impact on Airline Industry Competition

Eq.(4) : $\Delta HHIRPM = \beta_0 + \beta_1 LCC + \beta_2 \Delta PaxIndustry + \eta_2$

Variables	Estimates	Standard Errors	tValue	Tolerance	Variance Inflation
Intercept	0.04444	0.15974	0.28	-	-
LCC	-0.17537	0.08803	-1.99**	0.95084	1.05170
ΔPaxIndustry	5.35561	1.55276	3.45***	0.95084	1.05170

TABLE 5
TWO-STAGE LEAST SQUARES REGRESSION RESULTS. (CONTINUED)

Panel B: Network Expansion Benefits of LCC Entry

Eq.(5) : $\Delta RPM = \gamma_0 + \gamma_1 LCC + \gamma_2 \Delta GDPService + \nu_1$

Variables	Estimates	Standard Errors	tValue	Tolerance	Variance Inflation
Intercept	-5.22843	2.52759	-2.07*	-	-
LCC	0.76278	0.37589	2.01*	0.97594	1.02466
ΔGDPService	3.69670	1.55527	2.38*	0.97594	1.02466

Panel C: Stock returns response to competition and network expansion generated by LCC entry.

Eq.(6) : $R_{i,q} = \alpha_0 + \alpha_1 \Delta HHIRPM + \alpha_2 \Delta RPM + \alpha_3 (Rm\text{-}Rf) + \alpha_4 SMB + \alpha_5 HML + \varepsilon_1$

Variables	Estimates	Standard Errors	tValue	Tolerance	Variance Inflation
Intercept	-0.09771	0.02025	-4.82***	-	-
ΔHHIRPM	-0.07581	0.0355	-2.13**	0.97372	1.02699
ΔRPM	0.02849	0.01019	2.80***	0.96752	1.03358
Rm-Rf	0.02368	0.00215	11.04**	0.69912	1.43038
SMB	-0.000789	0.003283	-0.28	0.78724	1.27025
HML	0.01292	0.00205	6.31***	0.86541	1.15552

*, **, and *** indicate statistical significance at 0.10, 0.05 and 0.01 levels respectively.

Panel B presents the estimates from the equation (5) for spillover benefits of network expansion. The coefficient of LCC entry is positive and significant at the 0.05 level. This implies that an increase in number of low cost carriers increases overall business activity in the airline sector, with some portion of this increase accruing to the legacy airlines. Our control variable in this regression is economic growth, particularly in the service industry (measured by GDP Services), because demand for airline travel is expected to increase in a growing economy. The coefficient is positive and significant as hypothesized.

Panel C presents the second stage regression results for airline stock returns using the predicted values for competition and network expansion from the first stage regressions, which become our key explanatory variables. The coefficient on the Herfindahl-Hirschman Index (HHI), which is an inverse measure of competition, is negative 7% while that of network expansion is positive 3%. These results are in line with the intuition that the entry of an LCC generates a trade-off between increased competitions versus increased opportunities resulting from network expansion. The coefficient for the control variable, quarterly market return shows a significant and positive relation with airline returns. The results of regression support our hypotheses that after controlling for overall market return, the stock return of legacy airlines are impacted negatively from higher competition and positively from network expansion.

VII. CONCLUSIONS

This study examined the impact on the stock prices of major legacy airlines of LCC entry announcements and actual entries into the airport markets of established carriers. As a surprising result, significant positive abnormal returns are observed. These effects of LCC entry may be explained either by the more critical importance of other variables or, more likely, by the economic factor of positive network externalities, in the form of spillovers or economies of scope, that increase the revenues of legacy airlines. We examine the broader view from quarterly data with two stage least squares regression models. We posit that there are two possible explanations for the effects of LCC entry and that these have contrasting impacts: the first is competition and the second is network expansion.

First, the legacy airlines face a higher level of competition when LCCs enter their markets with new routes. Since the deregulation of the airline industry three decades ago, numerous upstart airlines have tried to copy the business model of Southwest Airlines. Most investors are likely to consider an LCC entry as a catalyst of increased competition in the industry. In contrast, the network expansion effect from LCC entry into the market of an established airline may enhance the position of the legacy carrier by producing positive economic externalities or spillovers instead of a loss of market share. These externalities are achieved through economies of scope by the aggregation and enhancement of transportation opportunities within the airport area. If a new LCC enters an airport, it may increase the air traffic and connections between open routes of major airlines and increase the number of passengers into the airport from sources where no connection previously existed. Or the LCC entry may connect more people to that airport, even if an established carrier previously served the same city-pair. Because an LCC reduces the airfares on that route, more people can afford to fly the route, and the demand for tickets on the connecting network airline is increased. Usually, the established carrier has been in the airport for a longer time and serves more and further destinations. More passengers flying into the airport on the new LCC route result in increased demand for connecting flights of the established carriers. Thus, an LCC entry may increase revenues and enplanements of the network carriers by providing more connecting customers and fulfil an objective of the hub-and-spoke system. As a result, stock prices of the legacy airlines would increase rather than decrease. Thus, investors could consider the LCC entry to be a marginal event in terms of anticipated effects on the revenue of legacy airlines and more significant in terms of providing a competitive catalyst. Alternately, the entry of an LCC could be an event with low impact that is blurred by more significant events. The airline industry is dependent on many factors, such as oil prices and the macroeconomic situation, and these often produce an unstable oligopoly environment. In this scenario, mergers and acquisitions, as well as bankruptcies, may be more likely to impact stock prices than the entry of competing LCCs (Rubin and Joy [2005]).

In the short run the unexpected results we find for three day cumulative abnormal returns (CAR) could be due to several limitations of this study that may be explored in future research. First, LCC entries into hubs are more meaningful to the legacy airlines than LCC entries into other major airports, because the largest components of the network carrier operations are located in their hub airports. Based on the limited number of hub airports, the sample of entries into hubs does not include enough events to produce meaningful results. In future research, sample size might be expanded by increasing the number of LCCs. Alternately, the number of airports could be increased instead of using only entries into the largest and hub airports. Additionally, the first LCC entry into a particular airport could be more significant than subsequent entries because, in that initial case, investors do not know how much an LCC entry affects the revenues of legacy airlines. This alternative approach would probably place more focus on Southwest Airlines, which was the first LCC into most airports. Further, this alternative would severely limit the number of entry and announcement dates for analysis and, based on our results for hubs only, would probably yield insignificant results. Future research could use a different definition of a market of the legacy airlines. While this study defines a market as an airport location, an alternative approach could define a market as a route between two cities. If an LCC added a new city-pair, possibly one of the most profitable routes for an established carrier, the network airline might incur larger impacts if it is forced to lower its airfares, thereby reducing profit.

Despite these considerations, the airline industry is a critical transportation medium in an increasingly global world, particularly for business, and provides a dynamic field of study with many approaches for research. Due to its oligopoly structure, unique economic and financial analyses can be studied. Further, besides insurance companies, airlines were undoubtedly the companies that were most affected by the terrorist attacks of September 11, 2001. In the aftermath, airlines went bankrupt or were forced into mergers; the most recent examples are the bankruptcy of ATA Airlines, the withdrawal of Frontier from several airports and the 2008 merger of Delta and Northwest Airlines.

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CONCLUSIONS

My dissertation consists of two essays concerning corporate announcements and their effects on market responses. The first essay investigates the information contents from corporate earnings announcements in the after-hours sessions. The second essay examines the effects of low cost airline announcements and entries on the legacy airlines on the basis of competition and network expansion.

In essay 1, we find that investors react immediately upon corporate earnings announcements within the after-hours sessions. Even though after-hours trading volume is relatively low compared to the regular trading hours, we find that trading activities are greatly heightened up on the earnings announcement days when compared to the non-announcement days. We provide the empirical evidence suggesting that after-hours trading play a significant role in allowing investors to react quickly to breaking news stories or the most up-to-date information. We find that the investors act quickly following the earnings announcements when we observe immediate price reaction during the after-hours periods. The trades during the BMO and AMC periods contribute 36% and 60% of price changes, respectively. Price discovery are also much higher for the AHT following the event despite relatively low volume. We also find that prices in AHT show a large degree of information efficiency, which demonstrates that prices are not likely to be completely driven by noise trading.

Essay 2 presents the impacts from the entry announcement by low cost carriers (LCCs) on the legacy airlines. As opposed to previous findings, we find significant positive abnormal returns of legacy airline stocks on the announcements and entry dates of LCCs. One explanation is that when LCCs enter their market with new routes, the legacy airlines face a higher level of competition while they also benefit from network expansion of LCCs' new routes. LCCs may help increase the air traffic and connections between open routes of major airlines and increase the number of passengers for the airport from sources that were not previously served. As a result, stock prices of the legacy airlines would increase rather than decrease. We then examine the broader view from quarterly data with two stage square regression models. The regression results show that the entry of LCCs creates the higher level of competition in the industry and increases the overall business activity of the legacy airlines. The regression results on the stock return of legacy airlines after controlling for overall market condition also supports our hypotheses. The stock returns of legacy airlines are affected negatively by higher competition and positively by network expansion.